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The RUBBER AGE

VOL. 48, No. 5 FEBRUARY, 1941

Oidium Mildew on Rubber Plantations —and Its Prevention

By ERIC HARDY, F.Z.S.

ONE of the principal costs of rubber production in Malaya and the East is the extent to which plant diseases and fungi attack plantations. One of the most extensive of these is *Oidium* mildew, a relative mould of another fungus called *Phytophthora* which causes extensive leaf fall of vines and herbs in virulent outbreaks. However, botanical science is making steady progress in the conquest of these rubber plantation diseases and it is hoped that they can not only be localized to prevent world-wide difficulties by their reaching American trees, but also that the time is perhaps not far distant when their damage may be negligible. Rubber root disease can now be controlled since the discovery that old stumps are the focal points of the disease. These stumps are now treated with sodium arsenate to check the distribution of spores.

Oidium mildew, or mould, the most serious of all rubber diseases, has for some time been treated with direct application of flowers of sulfur powder or liver of sulfur sprays, but a biological technique has been developed as a result of careful scientific investigation which has led to the recognition of high and poor yielding strains and the selection of high-yielding "mother trees" for budding. Hybridizing work with rubber strains is now being carried out in the hope of developing strains naturally resistant to *Oidium* mildew.

A very close study has been made of the life history of this fungus, which chiefly attacks the old trees, its damage depending to a considerable extent upon weather conditions during the winter resting season. Scientifically known as *Oidium heveae,* it generally occurs in virulent outbreaks of stem, branch and leaf disease when there are light showers of rain during a wintering period which has previously been excessively dry, resulting in a refoliation of the trees at a much slower rate than usual, a larger period being left with the young leaf liable to attack. Although the mildew chiefly attacks old trees, it is the new young leaves which are its growing medium and if these can be rushed through their early stages quicker than usual there is less risk of their receiving the fungus growth.

In Java and Malaya the attacks of rubber disease have occurred most where the soil is poor and exhausted, and the trees, receiving less nourishment, are slower in growth. Higher estates are also more seriously attacked than those of lower altitudes, but there are instances of confusion between leaf fall from *Oidium* and leaf fall from the *Phytophthora* fungi.

The disease has not yet occurred in India and Burma where every effort is being made to isolate it from those plantations, but it was first noticed in Ceylon and Malaya in 1925, having appeared in Java and Sumatra in 1918. Its spread has since been so rapid as to become a serious economic question with the rubber producing industry, and it is really the only serious leaf disease in the Malayan plantations. Its seriousness was one of the main points made by Sir Frederick Stockdale (at the outbreak of war) on the application of economic botany in the Tropics.

Oidium mildew belongs to the powdery mildews or *Erysiphaceae* group of moulds or fungi; it is an obligate parasite with delicate cobweb-like masses of mycelium or growth-hairs which form a superficial covering

over the surface of attacked leaves, the covering being generally incomplete. It produces its fruits or spore-bearing cases in the form of conidiophores, little stalks with a bead-like chain of conidia or spore-cases as a sign of maturity.

When contamination first occurs the small spots of growing fungus threads on the leaf look like blobs of whitewash, or a slightly glistening, furry surface. This is not always easily visible since the spots are generally near the leaf vein and the midrib of the leaf on the under surface, in order to obtain shade from the midday sun. It appears that the fungus cannot thrive in direct sunlight.

The mildew feeds on the cells of the leaf skin, and at maturity the many spores borne on the short, erect conidiophores give the under part of the leaf a characteristic powdery appearance. It also attacks the flowers of the rubber trees so that the production of seed for use in future plantings is considerably reduced. Its occurrence is always on the young leaves, during or immediately after the winter season when the young leaves are in the bronze or green-bronze stage, but in Java it has attacked rubber seedlings in the nurseries.

As with the closely related *Oidium Tuckeri* mildew of European vines, the rubber disease is itself attacked by a parasitic fungus, *Cicinnobilis*, which tends to keep it in check in some places, but not in Malaya. It is unlikely however, that this parasitic fungus could be utilized to have any more than an insignificant effect upon the serious spread of the disease among the rubber plantations. Leaves that have been attacked by *Oidium* become dull, they crinkle and turn bluish-black and soon fall, but once they pass the early stage they may continue to live, since attacks upon mature leaves are few. There are also some insect pests of the rubber trees—spiders, weevils and especially mites, which attack the leaves and cause similar disfigurement and premature leaf fall. These insects play a large part in the distribution of the spores of *Oidium* and in infecting new areas.

That spores may also be transported accidentally by airplanes in inter-continental travel, especially on the wartime east to west routes across the Tropics, is a danger that cannot be overlooked. There is much more likelihood of the survival of spores in the short time of aerial conditions than through longer transport by ship.

Moreover, the fact that the same species of rubber tree cultivated in the plantations of Malaya and the East produce the "wild" rubber from the South American forests points the danger of possible contamination of the Brazilian trees with spores accidentally transported by commerce from the East. The introduction of European and Asiatic agricultural pests into North America, with very costly results, can stand as an example.

Oidium mildew is soon checked when atmospheric conditions are against its requirements, for it is a relatively short-lived fungus. Its favorite conditions for spread are a temperature range between 56° and 62° F. and humidity of 75% to 80%. Frequent, heavy rains increase the disease; infrequent rains retard and check it. In Malaya, the great difference between day and night temperatures, and the heavy April rains, encourages rapid growth of the young leaves and so checks much exposure to destruction.

The healthiest trees grow on virgin soil, free from soil wash. Trees that have been attacked may receive a second attack after refoliation, except during dry conditions. Infection of the rubber plantations may also come from other plants which act as host to this mildew, for *Oidium heveae* has been found on thirty-one species of plants in Ceylon alone.

In addition to the new plant-breeding methods of control, field fungicides include the practice of sulfur-dusting with a power duster used early in the season in dry weather. The weather, however, is the ideal control, if this can consist of either completely heavy rain or complete lack of rain. The usual precautions are to sulfur-dust the trees, using 5 pounds of sulfur per acre.

Nypene Resin

A NEW terpene polymer resin, called Nypene Resin, has been introduced by the Neville Co., manufacturers of coal-tar products, Neville Island, Pittsburgh, Penna. The new material has a melting point of 140-150° C., pale color, and is neutral and non-saponifiable. It has good resistance to water, acids, and alkalies. The most interesting properties of the resin are said to be its compatibility with paraffin, natural and mineral waxes, and its exceptional softening action on rubber. It is compatible with Vistanex polybutene.

Originating from turpentine, Nypene differs from rosin in that it has a strictly hydrocarbon structure. On intensive ultra violet exposure, it yellows less than ester gum, and very much less than coumarone or petroleum resins. The slight degree of yellowing shown by the new resin is comparable to that of a good grade of wood rosin with, of course, superior reagent resistance.

Nypene is odorless when cold and has a clean, sweet, pleasant terpene odor when melted. The specific gravity is less than one (about 0.98), with obvious advantage for use in products sold on a volume basis. It should be particularly useful for alcohol resistant coatings in conjunction with Pliolite. Neither of these materials was affected by nine days exposure to denatured alcohol. As solution or cut-back, Nypene imparts initial tack to latex. Blended with 60% rubber, it behaves as a pressure sensitive adhesive, suitable for most jobs except rubber to rubber.

Although physically a resin, Nypene shows a remarkable similarity to rubber. The hydrogen-carbon ratio is high, approximately the same as rubber. It is insoluble in acetone. It is compatible with rubber in all proportions and yields compounds of exceptional clarity. In spite of the high melting point of Nypene, it serves to soften and plasticize rubber. It is compatible with all forms of unvulcanized rubber, including latex. It is not compatible with vulcanized rubber but is compatible with all grades of polybutenes in all proportions.

Properties, Processing and Compounding of Hycar O.R. Synthetic Rubber

Ever since the announcement of the availability of Hycar synthetic rubber for commercial purposes by the Hydrocarbon Chemical and Rubber Company, the rubber manufacturing industry has been awaiting further details concerning the properties, characteristics and performance of this new material. The following data, taken from a compounding manual just brought out by the company, constitutes the first article on Hycar to appear in any rubber journal.—The Editor.

General Properties and Uses

HYCAR O.R. is a synthetic rubber, manufactured from domestically produced butadiene, which has the appearance and physical characteristics of crude plantation thick crepe rubber. In chemical composition it is a modified butadiene co-polymer. In appearance it is similar to a light tan to amber colored crepe rubber. It has a specific gravity of 1.0, a pleasant characteristic odor, excellent storage stability, and presents no health hazards. The compounding, curing and fabrication of Hycar O.R. is the same as rubber. In milling, it is very similar to rubber, but mill rolls should be kept relatively cold (120° F.) and roll friction ratio should be low (1:1.3) or less.

Hycar O.R. compounds are reported to give good resistance to mineral oils, vegetable oils and fats, animal oils and fats, petroleum hydrocarbons and solvents, printing inks and paint driers, dilute acids and alkalis, set and creep, heat, oxidation, fatigue, static aging and abrasion. They may be used where any one or a combination of these properties is important.

The Compounding of Hycar

The compounding of Hycar O.R. is very similar to the compounding of natural rubber, and the same general principles are applicable provided allowance is made for certain minor specific differences which are detailed in the following paragraphs.

Sulfur and Accelerator

Hycar O.R. is vulcanized with sulfur and accelerators as is natural rubber, but in general the sulfur should be decreased slightly, with an increase in the amount of accelerator. The preferred amount of sulfur and accelerator is generally between 1 and 2 parts on a hundred parts of Hycar O.R. Thus for a tread type stock, 1.25 parts of sulfur and 1.25 parts of benzothiazyl disulfide would be a suitable sulfur-accelerator ratio. When large amounts of softeners are used, it is generally desirable to increase the sulfur and accelerator, especially when the softener is one which combines with sulfur. The softeners which combine with or absorb sulfur may be listed in the order of descending absorption, Cardolites, rosins, cumars and coal tars.

In general, it has been found that the sulfur and accelerator should be increased .01 part for each part increase of the above softeners over and above the 15 parts of the softener present in a compound carrying 1.25 parts of sulfur and 1.25 parts accelerator per hundred parts of Hycar O.R. If a compound is to be used in high temperature service, it is recommended that a series of accelerator-sulfur ratios be run to ascertain the proper amount of sulfur required since excessive sulfur decreases the elongation and increases the durometer hardness.

The effect of different accelerators on the rate of cure of Hycar O.R. is approximately the same as with natural rubber, and similarly the rate of cure may be increased by using more accelerator or by using ultra accelerators such as tetra methyl thiuram disulfide. As when used in rubber compounds, ultra accelerators increase the processing difficulties and care must be used to prevent scorching.

The best type of heat resisting stock is obtained through the use of tetra methyl thiuram disulfide or mixtures of this with mercaptobenzothiazol or benzothiazyl disulfide with none or a minimum amount of free sulfur.

Of the metallic oxides, litharge has been found to be a very satisfactory accelerator for vulcanization. For litharge accelerated compounds, 1 to 2 parts of sulfur are used in combination with 7 to 10 parts of litharge per hundred parts of Hycar O.R.

Zinc oxide is required to activate most accelerators and is recommended to be used in quantities of from 3 to 5 parts per hundred of Hycar O.R.

Pigments

The high tensile properties of compounded Hycar O.R. are not obtained in pure gum compounds, however, with reenforcing pigments, compounds with high tensile strength may be readily obtained. Channel black is outstanding in this respect, followed by the softer blacks, fine particle size whitings and clays, light calcined magnesia and zinc oxide. The usual inert fillers do not add tensile strength to Hycar O.R. compounds.

Channel Black is used to produce high tensile, good tear and abrasion resistant compounds.

Semi-Reenforcing Blacks produce compounds having somewhat higher elongations, more resilience, lower permanent set, better fatigue and flex resistance but lower tensiles than channel black.

Zinc Oxide as mentioned previously is used in small quantities for accelerator activation. High loadings of 25 to 150 parts of zinc oxide per hundred parts of Hycar O.R. produce compounds which have better tack and building characteristics.

Certain fine particle size clays give fair tensile

properties and may be used in light colored compounds. However, these compounds have high permanent set and low rebound elasticity characteristics.

Inert Fillers such as barytes, whitings, lithopones are used primarily for reduction of cost. Whiting aids in processing and produces stocks which extrude more easily. When these inert fillers are used, properties such as tensile strength, low set and abrasion resistance are sacrificed.

Waxes are used to improve extrusion, sun checking and flex cracking. They are not to be used in amounts exceeding 2 parts per hundred of Hycar O.R. as larger amounts are difficult to incorporate and will bloom excessively, reducing the tackiness of the compound. The common waxes which have been found most suitable for Hycar O.R. compounds are paraffin, Syncera, Sunproof and Heliozone.

Softeners

Much larger amounts of softener may be used with Hycar O.R. than with natural rubber and usually these larger amounts aid processing. Many compounds will contain 25 to 50 parts of softener per 100 parts of Hycar O.R. Some of the common rubber softeners such as soft coal tar, cumar, and factice as well as the lacquer placticizers have been found to be excellent softeners for use in Hycar O.R. compounds. The high solvent and oil resistance of Hycar O.R. necessitates the careful choice of softeners to prevent bleeding after cure. In general, the more aliphatic or paraffin-like the material, the *less* suitable it is as a softener.

Where a compound is to be used for solvent resistance it is advisable to select a softener which will either not be extracted in service or, if partially extracted, the resultant product will continue to be satisfactory for service. There is some shrinkage in most of the compounds listed later and this is due to extraction of the plasticizer when it is present in large quantities. Further, the solvents used were for standard laboratory evaluation with no particular selection of softener for a specific service or resistance to solvent extraction.

Different classes of softeners affect the final properties of Hycar O.R. vulcanizates. In order to obtain a soft snappy low set compound which is free from odor it is necessary to use types of softeners or plasticizers common to the lacquer and cellulose industries, such as the ester type plasticizers—dibutyl phthalate, tricresyl phosphate, etc. Soft coal tars, coal tar products and cumar resins are good softeners for aiding in processing and are considerably lower in cost. These softeners give compounds which are usually loggy and carry the odor of the plasticizer used. It is often advisable to use a combination of different types of softeners in order to obtain the best results.

To increase resilience such softeners as dibutyl phthalate, tricresyl phosphate, Bardol "B", and triacetin may be used. To obtain better tack or compounds which are susceptible to tackifying solutions, the following softeners may be used: soft coal tar, dioctyl phthalate, Nevoll, Cumar resins, and Dispersing Oil No. 10. To aid extrusion these softeners are suggested: Tetralin, Factice (soft), wool grease (degras), stearic acid, lauric acid, paraffin and other waxes. The last four softeners should be used in limited amounts, with a 2% maximum.

Antioxidants

Hycar O.R. contains approximately 2% phenyl-betanaphthylamine as an antioxidant and for most purposes this is adequate protection. When heat resistant compounds are desired it is advisable to add from 2 to 5 parts of ketone-amine reaction product tvpe antioxidants, such as Agerite Resin "D," Aminox, B.L.E. or Flectol B or H per hundred parts of Hycar O.R.

Mixtures with Natural Rubber and Other Synthetics

Hycar O.R. may be blended with either natural rubber or reclaims in all proportions and these blends retain in a proportionate measure the low swelling characteristics of Hycar O.R. It can also be blended with Koroseal, neoprene, Thiokol, etc., and often such blends have a more desirable combination of properties than either material by itself. This compatability feature of Hycar O.R. permits the compounder to meet product specifications, at a reduced over-all cost.

When mixing Hycar O.R. with natural rubber, Koroseal, neoprene, Thiokol, etc., each should be masticated separately to approximately the same plasticity before blending. This type of operation may require the incorporation of some of the softeners into the Hycar O.R. before it is of the same order of softness as the material with which it is to be blended.

Processing of Hycar

The processing of Hycar O.R. is sufficiently different from that of natural rubber to warrant careful handling in both factory and laboratory operations. The most satisfactory procedure will be to follow the detailed processing outline given with the recipes until the operators become familiar with the processing characteristics of Hycar O.R. They may then use their experience as a guide to modify these procedures in such ways as seem desirable for factory or laboratory processing. The procedures finally adopted in the factory will not differ greatly from those currently used for natural rubber compounds.

Mastication: Hycar O.R. is less thermoplastic than natural rubber and does not break down as quickly or to the same extent as rubber. For this reason Hycar O.R. generates more heat during the milling operation and therefore the mill rolls must be kept relatively cool. For the same reason a mill roll speed ratio should be as low as possible to avoid increased heat due to friction. A friction mill roll ratio of 1 to 1.30 or less having a roll temperature below 120° F. has been found to be most satisfactory.

Although Hycar O.R. does not break down to the same extent as natural rubber, mastication or breakdown is of great importance in mixing batches which will process satisfactorily and for this reason a somewhat smaller batch size as compared to rubber is recommended.

Hycar O.R. should be masticated on a tight mill and given a certain amount of mechanical breakdown before the addition of pigments or softeners, with the possible exception of age resister and accelerator. It is advisable to pass the Hycar O.R. through the mill three or four times before allowing it to form a band around the roll. Adequate mastication usually requires 5 to 15 minutes depending on the size of the mill and the amount of Hycar O.R. used.

Softener Addition

When there are less than 30 parts of softener per hundred parts of Hycar O.R. the following procedure is recommended: After the Hycar O.R. is properly masticated, add the accelerator and antioxidant, these are followed by the softeners, zinc oxide, pigments and finally the sulfur. With larger amounts of softeners it is best to add part of the softener before the pigment and the remaining softener with the pigment unless the pigmentation is channel black. If the compound is high in channel black, the softener should be added in two portions, one before the black and one portion after the black has been incorporated. The softener should be added slowly enough so that the stock does not break away from the roll. Cutting the batch frequently is recommended. The time required for addition varies considerably with the nature of the softener used. Coal tars, cumars and like materials incorporate much faster than the ester type plasticizers, such as dibutyl phthalate, tricresyl phosphate, etc.

Pigment Addition

With high channel black and especially compounds low in softener, it is essential to mix carefully and to use small batches. The black should be added slowly and prior to the greasy type materials (wool grease, paraffin, stearic acid, etc.) and the banded stock should not be allowed to break away from the roll. Occasional cutting and blending facilitates mixing but the batch should not be cut with free black or pigment on the rolls. The cut surface of a well dispersed channel black batch has a glossy black appearance. If mixed batch does not have such an appearance, it should be allowed to cool and then be remilled.

Semi-reenforcing blacks disperse somewhat more easily than channel black, while the soft blacks are dispersed much more readily. The same general procedure for mixing channel black compounds may be followed with the soft blacks except that they require less time and less care. When the batch contains both hard and soft blacks, it is best to add the hard black first, although satisfactory stocks can be obtained by mixing the blacks and adding them together.

Other pigments can usually be added in the same manner as the soft blacks with alternation of pigment and softener (when in large amounts) if neither is added too rapidly.

Calendering

Hycar O.R. compounds in general calender very well. Specific optimum calender conditions must of course be found for each individual stock. The following general recommendations are made for the various types of calendering.

Sheeted Stock: Hycar O.R. compounds possess less tack than corresponding rubber stock of the same plasticity. It is therefore necessary in some cases to use a bottom roll squeeze calender in order to obtain satisfactory ply adhesion. However, stock properly compounded with softeners and tackifying agents can usually be run satisfactorily on a cloth roll calender.

On the calender, Hycar O.R. stocks have a tendency to trap air and blister somewhat more than natural rubber stocks, but with a tight wrap down in the liner these blisters will in most cases disappear which feature permits sheeting to approximately the same ply gage thickness as with natural rubber compounds.

Unlike natural rubber, high calender temperatures do not improve tack or ply adhesion. In most cases medium heats (110° to 150° F.) have been found to give satisfactory calendering operation for sheeted stocks. Like rubber, calender ratios must be worked out for each individual compound.

Frictioning: Friction stocks must be compounded carefully in order to insure sufficient tack. For best frictioning results it is desirable to use warm dry fabric. Calender roll temperatures will vary depending on the loading and tackifying agents but in general higher temperatures (160° to 180° F.) are required for frictioning than for sheeting.

Coating: For satisfactory coating it is desirable to have a more tacky stock than is ordinarily used for sheeting and a less tacky stock than is used for frictioning. Coating is ordinarily done at an odd speed ratio with roll temperatures somewhat higher than for sheeting.

Lamination

The amount and nature of the softener present in the recipe has considerable influence on the tackiness of the compound; however, due to the differences in the tack characteristics of Hycar O.R. as compared with rubber, it is generally necessary in all types of compounds to use solvents or tackifiers in building operations. Either methyl ethyl ketone or a 5% solution of ethyl phthalyl ethyl glycollate in methyl ethyl ketone has been found to be a satisfactory tackifying agent. Since gases do not permeate Hycar O.R. as readily as they do natural rubber, it is essential that all air be eliminated between the plies during build-up.

Tubing

Hycar O.R. compounds, in general, tube very well. Tubing difficulties may occur as a result of improper compounding or mixing. Best tubing results are obtained when the screw and the barrel of the machine are cool and the die sufficiently hot to insure a smooth surface on the extruded article.

Molding and Curing

The molding and curing of Hycar O.R. articles are accomplished with the same practices and equipment as those used for articles made from natural rubber.

Adhesion of Hycar Compounds to Metals

Hycar O.R. compounds can be bonded to many metals and materials through the use of a chlorinated rubber solution. This solution should consist of fifteen parts of chlorinated rubber per one hundred parts of toluol plus one part of a plasticizer, such as tetralin, dibutyl phthalate, or triphenyl phosphate.

Surfaces should be clean and free from oil and grease and in most cases etched or roughened. When applying to ferrous metals, sand blasting is recommended. Two to four coats of cement should be applied to the metals or materials allowing each coat to dry before applying the next coat. The surface of the Hycar O.R. compound to be applied should be freshened with a light coat of a Hycar O.R. solvent.

Where only chlorinated rubber solutions are not entirely satisfactory to bond Hycar O.R. to metal or

other materials, it is recommended that a cement made from a solution of chlorinated rubber and a dissolved Hycar O.R. compound be used.

Compounding Ingredients and Their Effect

The following recipes tend to show the effect of different types of softeners and reenforcing agents. They are not recipes developed for special uses, but merely show change in physical properties resulting from increasing the amounts of the two general types of softeners and the use of high loadings of the three common types of gas black.

Softener Study

The following three recipes show the effect of increasing the amount of soft coal tar type softener. It should be noted that it is necessary to increase the amount of accelerator and sulfur when the softener is increased considerably.

Compound No.	*1HCR1*	*1HCR2*	*1HCR3*
Hycar O. R.	100.00	100.00	100.00
Zinc Oxide	5.00	5.00	5.00
Phenylbetanaphthylamine	1.00	1.00	1.00
Benzothiazyl Disulfide	1.00	1.25	1.50
Sulfur	1.00	1.25	1.50
Channel Black	50.00	50.00	50.00
Stearic Acid	1.00	1.00	1.00
Soft Coal Tar	5.00	25.00	50.00
	164.00	184.50	210.00
Physical Properties—Cure 20 Minutes at 310° F.			
Stress at 300%	1800	1000	700
Ult. Tensile lbs./sq. in.	3500	3200	2400
Ult. Elong. %	450	600	675
Shore Hardness	74	70	66
Schopper Rebound %	14	11	8
Compression Set % (Deflection Method)	8	8	8.5
% Volume Change Resulting from Immersions in Various Solvents			
Hexane 48 Hours at 25° C.	+3	0	0
Circo Light Proc. Oil for 48 Hours at 100° C.	+6.1	0	—8.4

These three recipes show the effect of increasing the amount of an ester type softener, with a corresponding increase in the amount of sulfur and accelerator.

Compound No.	*1HCR4*	*1HCR5*	*1HCR6*
Hycar O. R.	100.00	100.00	100.00
Zinc Oxide	5.00	5.00	5.00
Phenylbetanaphthylamine	1.00	1.00	1.00
Benzothiazyl Disulfide	1.25	1.50	2.00
Sulfur	1.25	1.50	3.00
Channel Black	50.00	50.00	50.00
Stearic Acid	1.00	1.00	1.00
Dibutyl Phthalate	25.00	50.00	100.00
	184.50	210.00	262.00
Physical Properties—Cure 20 Minutes at 310° F.			
Stress at 300% lbs./sq. in.	1200	800	500
Ult. Tensile lbs./sq. in.	2800	1900	800
Ult. Elong. %	500	520	400
Shore Hardness	61	46	40
Schopper Rebound %	28	39	48
Compression Set % (Deflection Method)	7.5	10.5	14
% Volume Change Resulting from Immersions in Various Solvents			
Hexane 48 Hours at 25° C.	+3.0	—8.4*	—24.2*
Circo Light Proc. Oil for 48 Hours at 100° C.	—6.1*	—34.0*	—38.6*

* Shrinkage is due to extraction of excessive plasticizer.

Black Study

The three following recipes are typical compounds loaded with channel black, semi-reinforcing type black and a soft type black. One hundred parts of channel black is approximately the maximum amount which can be incorporated in the type recipe shown below, while 150 parts of the other blacks can be mixed in satisfactorily.

Compound No.	*1HCR7*	*1HCR8*	*1HCR9*
Hycar O. R.	100.00	100.00	100.00
Zinc Oxide	5.00	5.00	5.00
Phenylbetanaphthylamine	1.50	1.50	1.50
Benzothiazyl Disulfide	1.25	1.25	1.25
Sulfur	1.25	1.25	1.25
Channel Black	100.00	—	—
Semi-Reinforcing Black	—	150.00	—
Soft Type Black	—	—	150.00
Stearic Acid	1.50	1.50	1.50
P-25 Cumar	10.00	10.00	10.00
Dibutyl Phthalate	15.00	15.00	15.00
	235.50	285.50	285.50
Physical Properties—Cure 30 Minutes at 310° F.			
Stress at 300% lbs./sq. in.	2400	—	900
Ult. Tensile lbs./sq. in.	3250	1800	1200
Ult. Elong. %	405	280	500
Shore Hardness	77	79	65
Schopper Rebound %	14	20	30
Compression Set % (Deflection Method)	10	7	8.5
% Volume Change Resulting from Immersions in Various Solvents			
Hexane 48 Hours at 25° C.	+1.5	+1.5	+1.5
Circo Light Proc. Oil for 48 Hours at 100° C.	—3.0	—3.0	—3.0

New Baking Lacquer for Rubber

A NEW type of finishing material for rubber balls, rubber bulbs, hot water bottles, and other flexible molded rubber products, has been announced by the Stanley Chemical Co., East Berlin, Conn. It is furnished in clear to produce high gloss finishes on black or colored rubber stock and is also offered in any desired color in a pigmented formulation to produce opaque finishes.

The new material is a lacquer which requires baking for one-half hour at 260° F. to obtain maximum adhesion, flexibility and durability. When baked in that fashion the coating is extremely dry and flexible, having high resistance to alcohol. Rubber articles finished with this baking lacquer may be sterilized without effect upon the finish. The flexibility of the coating is unusual in that it will not crack at —10° F. The coating may be baked at a lower temperature for a longer period of time or for a shorter time at higher temperatures. While this will produce very interesting qualities the result will not be equivalent to the baking schedule recommended, according to the manufacturers.

The time and temperature of baking need not affect the cure of rubber compounds unfavorably as is proven by its present use in large production. Rubber compounds formulated for such baking operations can be produced. It may be desirable to partially cure molded products depending upon the baking of the finish to complete the cure.

New Chemical Laboratory of Monsanto's Rubber Service Department

THE research and analytical staff of the Rubber Service Department of Monsanto Chemical Company now occupies a new chemical laboratory recently completed at Nitro, West Virginia. The new laboratory is constructed of fireproof brick. The inside walls are finished with buff, glazed tile and the floor is covered with a two tone composition tile. Adequate floor space is provided to accommodate the various units in a single story, and the roof is designed to support a layer of water—an effective cooling aid during West Virginia's hot summer months. In addition a large capacity blower changes the air three times per minute.

The new building houses five research laboratories each designed to accommodate two chemists. In addition, it contains a library, an analytical laboratory, a store room, work room and a locker room with shower baths. All laboratory benches are equipped with gas, air, hot and cold water, vacuum, steam and electricity.

The Rubber Service Department is especially proud of its library. It contains a comprehensive collection of reference books on pure chemistry as well as on rubber chemistry and technology and receives the leading chemical and rubber magazines published here and abroad. In addition to providing the usual facilities for reading and study, the library is furnished to provide a conference room for the entire staff. All books and bound periodicals are contained on open, metal shelving.

The chemical staff comprises eleven research chemists, two research engineers, five analytical chemists, a latex technologist and a number of laboratory assistants. Since the entire time of the group is given over to the study of chemicals for use in rubber and latex, a broad and comprehensive investigation of rubber chemicals is maintained.

One of the five new research rooms.

At the present time problems under investigation include the development of new accelerators, antioxidants, softeners, retarders, flex checking materials and other products for use in rubber compounding. The latex compounding but not the testing is carried out here. The testing of all rubber products is done in the fully equipped rubber testing laboratory which is housed in a separate building.

An important aid to the Rubber Service Department's research program is the analytical laboratory. The analysis and identification of many new materials is conducted here thus leaving the research staff free to carry on a greater volume of exploratory research. The analytical laboratory has the further task of examining each batch of rubber chemicals prepared in the plant so as to assure the buyer of uniform products.

View of the desks outside each of the research rooms and the well-stocked library.

Announcing a SYMPOSIUM *on*

NEW DEVELOPMENTS IN THE PROCESSING OF RUBBER

At the Meeting of the Division of Rubber Chemistry, A.C.S.,
Hotel Mayfair, St. Louis, Mo., 1:30 P.M., on April 10, 1941.

INTRODUCTION by Dr. R. H. Gerke (Chairman, Rubber Div.), U. S. Rubber Company

DR. GERKE Says: Do you need to know (1) That the rubber industry is making rapid strides in utilizing new processes and equipment? (2) In what directions are the leaders in the rubber industry moving? (3) What your competition is doing and how these new developments are going to affect you?

If so, attend the Symposium on New Developments in the Processing of Rubber at St. Louis.

●

Cold Resistance of Synthetic Rubber—By W. J. McCortney, Chrysler Corporation.

MR. McCORTNEY Will Say: An accurate method for determining the cold resistance of rubber has been developed. This method is used to check the cold resistance of various synthetic rubbers, various compounds of these rubbers, and effects of different methods of processing. All tests are run at —40° C. The results show that small variations in processing and compounding show up greatly in stiffening characteristics at low temperatures.

Injection Molding—By H. W. Paine, M. L. Macht and W. E. Rahm, DuPont Viscoloid Corporation.

MR. PAINE Will Say: Injection molding is a process of forming articles by molding a powder, forcing it through a small orifice or gate into a cold, closed die, and ejecting it immediately. This method has decided advantages over compression and other older methods of molding. Lantern slides will be used to illustrate modern molding equipment and to indicate the advances incorporated in the new injection machines. A moving picture will illustrate the injection molding technique and articles made by the process will be displayed.

Instrumentation in the Rubber Industry—By C. P. Bosomworth, Firestone Tire & Rubber Company

MR. BOSOMWORTH Will Say: The rubber industry, like others, is eliminating the element of human variability by the introduction of machines equipped with accurate instruments for maintaining uniform quality. Instrumentation is playing an ever increasing role, particularly in rapid mixing and stock preparation in tubers and Banburys, in tire and tube curing, and in the correct shaping and size of extruded products. Maintaining accurate curing temperatures enables us to use superactive chemicals in compounding. Finished products can now be checked by x-rays, sound meters and traction slip recorders. Instrumentation has come a long way, but many major problems are still with the rubber industry.

Mechanical Developments in the Processing of Rubber—By Andrew Hale, Farrel-Birmingham Co., Inc.

MR. HALE Will Say: The mill room of the future will be a one-man mill room. Huge crackers, capable of taking entire frozen bales, will deliver warm and softened rubber direct to plasticators. Broken-down rubber will come forth in pellet form. Remote controls will feed compounding ingredients, rubber and reclaim pellets from bins to automatic scales and also regulate the Banbury cycles. The rubber pellets will be pre-blended in unprecedented quantities. Sheeting mills will give way to screw-fed pelletizers which will receive direct charges from mixers and deliver mixed stock pellets, automatically cooled, to individual bins where each batch will await laboratory release and then proceed to mills for sulfuring and warming.

X-Ray Studies of Rubber

Part 1—Fundamentals

By GEORGE L. CLARK

Professor of Chemistry,
University of Illinois,
Urbana, Illinois

The use of x-rays at present is chiefly of theoretical interest to rubber chemists and technologists. One of the leading exponents of the application of these rays in the rubber and other fields is Professor Clark. Because so much work has been done with rubber in recent years and so much more is planned, we believe the following article, the first of a series by the author, which discusses the fundamentals involved, will prove of decided interest to our readers. We are indebted to the R. T. Vanderbilt Company for permission to publish this series of articles following their appearance in "The Vanderbilt News," the first of which appeared in the January-February, 1941, issue—The Editor.

1. What are X-rays?

Forty-five years ago Wilhelm Konrad Roentgen *(1)*, professor of physics at the University of Würzburg, like so many other physicists all over the world, was experimenting with a cathode ray tube, which was simply an evacuated glass bulb through which a high voltage electrical discharge was passed between sealed-in electrodes. Already it was generally known that out from the cathode was streaming some kind of "rays," which could be bent out of their course by electric and magnetic fields, in such a way that they must have had a negative electric charge.

Only two years later, Sir J. J. Thomson identified cathode rays as streams of electrons. The cathode rays themselves did not penetrate through the glass walls of the evacuated bulb or tube. Roentgen, however, was deeply interested in the brilliant fluorescence of that portion of the glass directly opposite the target on which the cathode rays struck. With the foresight of genius he covered the whole lighted bulb with black paper so that no light could escape. But in the darkness of the room there was a little patch of luminescence several feet away from the bulb—a screen of barium platinocyanide lying on the bench.

Imagine the drama of that moment! The induction coil was disconnected from the cathode ray bulb, and the luminescent patch faded into darkness; on again, and again the glowing screen; a sheet of metal held between the bulb and the screen, and darkness; the shield withdrawn, and again light. Yes—out of that familiar cathode ray bulb, out through the glass walls, the black paper and several feet of air, was coming a completely invisible, penetrating radiation which, falling upon the sensitive chemical compound, barium platinocyanide, caused it to spring into glowing life. These rays were found to be unaffected by a magnet, thus differing completely from the stream inside of the

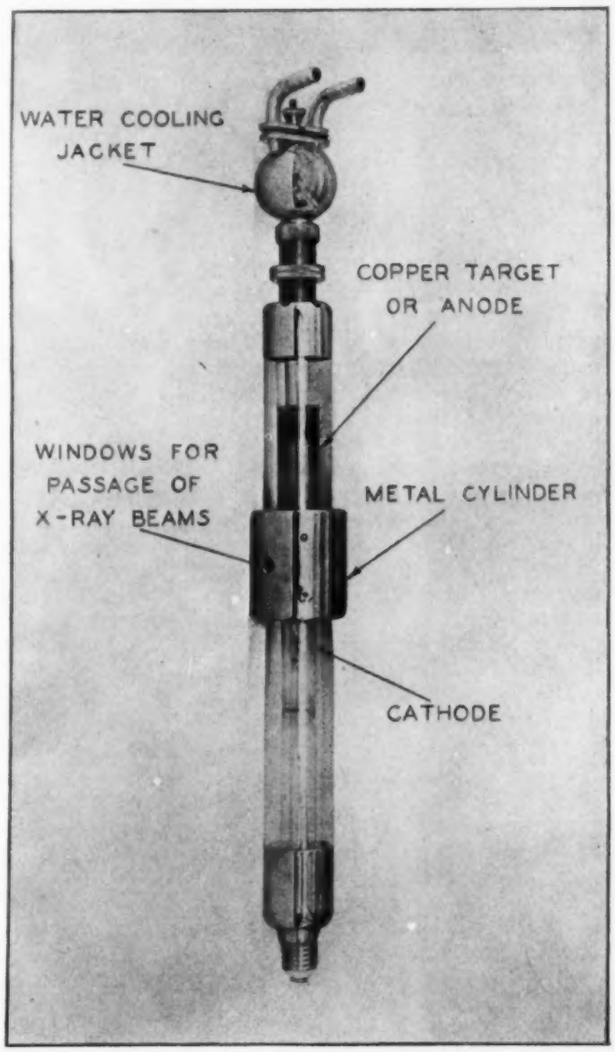


Figure 1. Philips x-ray tube.

(1) Today these rays, discovered by a German, are saving more lives than war can possibly destroy.

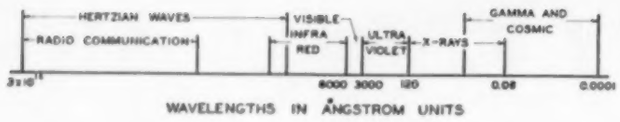


Figure 2. Electromagnetic spectrum.

bulb, but resembling an ordinary beam of light, which also is entirely unaffected by an electric or magnetic field.

Roentgen correctly deduced that when cathode rays, or streams of electrons, are stopped suddenly by a suitable obstacle or target, x-rays are emitted by that target and penetrate through the walls of the tube into the outer air. And this is precisely what happens in the thousands of x-ray tubes in operation today, whether they are tiny 4-inch dental tubes or giant 30-foot tubes operating at a million volts or more. For the modern x-ray tube, represented in Figure 1, still comprises an evacuated glass or metal tube, a source of electrons from a cathode which pass at high speed across an open space with the aid of a high potential difference and are stopped in their flight by the anode, which is actually, therefore, a target being bombarded by projectiles so small that they are the ultimate units of negative electricity.

Thus the energy of motion of these tiny material particles is suddenly transformed in the bombarding process partially into the energy of x-rays and partially into heat. X-ray tubes differ essentially only in the manner of producing the cathode rays and in engineering details of properly insulating the electrodes (cathode and target) from each other, and of removing the heat so that the target will not melt.

Now we come to the original question, "What are x-rays?" Roentgen, noting the negative effects of magnets on x-rays, immediately made the crucial experiments which might be expected to demonstrate further similarities with light. Four principal properties are associated with all phenomena in optics, namely: (1) reflection from mirrors; (2) refraction in prisms, or the bending of a light ray in passing from one medium into another (thus spreading white light into a "rainbow"); (3) diffraction, or the modification which light undergoes in passing by the edges of opaque bodies or through narrow slits, or in being reflected from ruled surfaces, in which the rays appear to be deflected or bent to produce fringes of parallel light and dark or colored bands; and (4) polarization, or the property of exhibiting different properties in different directions.

All of these properties are adequately accounted for by the theory that light is due to vibrations transverse to the direction of the ray propagated as waves. Light, invisible or visible, had long been characterized by wavelengths as experimentally measured in refraction or diffraction apparatus. The yellow light of sodium, for example, was given its correct wavelengths 5890 and 5896 Ångstrom units (1 Ångstrom unit is one one-hundred-millionth of a centimeter); and invisible ultraviolet light its wavelengths below about 4000 Å.U., and so on.

But the "X" remained. Roentgen was unable to demonstrate with the somewhat crude facilities at his command any of the four fundamental optical properties for the new rays. In fact it was not until 1920, after years of very accurate work with improved instruments for measuring some very minute effects, that it could be said, "Yes! X-rays can be reflected, refracted, diffracted and polarized, just as can ordinary light." The really crucial experiment came in 1912, when von Laue demonstrated the diffraction of x-rays by natural gratings—namely, crystals. So today there are no more "X's" in Roentgen rays than there are in those of classical optics. X-rays also are transverse electromagnetic vibrations. They also are characterized by wavelengths and they occupy merely one section of the total electromagnetic spectrum, shown in Figure 2, which extends from the shortest rays associated with cosmic rays, through the gamma rays of radium, then through x-rays, ultraviolet light, visible light, infrared or heat rays, and finally through the long Hertzian or radio waves.

We find it most convenient for our rubber investigations to use an x-ray beam from a copper-target tube, with a wavelength of 1.54 Å.U., which is about 1/4000 as long as a wave of yellow light. For this reason the x-ray is invisible; it is able to penetrate matter completely opaque to the yellow light; and surely it must make possible in some way or another the disclosure of a very much finer subdivision of matter than can be detected by light. But in fundamental optical properties and in velocity, x-ray and light ray are but members of the same great non-material radiation family, which finds its origin in what may be termed the unrest of electric charges.

2. Why are X-rays Used in the Study of Rubber Structure?

In attempting to resolve the fine structure of any material, it is clear that a very definite limit is reached in the microscope, which is conditioned by the wavelength of the visible or ultraviolet light employed. For these wavelengths are still considerably greater in magnitude than atomic or molecular dimensions, which, from many sources of estimation, are known to be of the order of a few Ångstrom units. But as we have already indicated, x-ray wavelengths are of the same order of magnitude as these molecular dimensions, and so it should be expected that x-radiation might be used to disclose the identity and size of the ultimate submolecular unit of rubber.

This information obviously cannot depend on an actual enlargement of an image of a molecule or part of

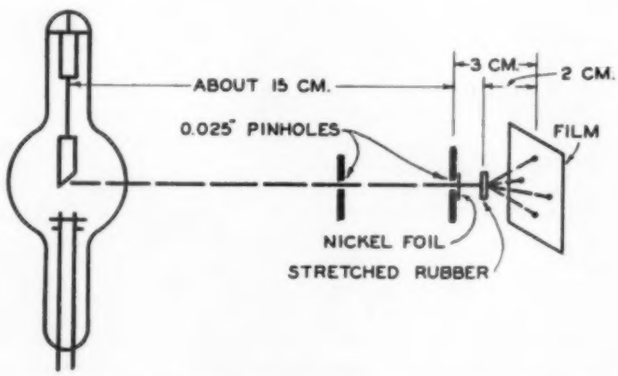


Figure 3. Arrangement of apparatus and sample for x-ray analysis.

a molecule, since there are no lenses for x-rays as there are for light. But as we shall see, this ultimate structure is derived as a result of an interaction between x-rays and the specimen, which is actually an example of the familiar optical principles of diffraction and reflection already mentioned. So, for measuring rubber molecules we use a comparable measuring stick—the length of x-ray waves.

3. How are X-rays Used for the Study of the Ultimate Building Plan of Rubber?

Figure 3 sketches the relative positions of the sample and of the various pieces of apparatus used in an x-ray analysis. The tube frequently used is the Philips metalix tube, made in Holland, and found very satisfactory in our laboratory. To a central cylinder of a special chromium alloy, in which there are four openings or windows, are sealed two glass sleeves, into which in turn are sealed the hot filament cathode and the water-cooled target. This tube is exhausted to a very high vacuum and sealed off at the factory. Figure 4 pictures the actual arrangement employed in the analysis of rubber structure.

The x-ray tube in this case is an all-glass General Electric tube in which are clearly apparent the cathode below, with the metal focusing cup around the filament, and the target above. To one side in line with a beam of x-rays emitted by the target at a grazing angle is a collimating tube about 4 inches long, in both ends of which are lead pinholes about 0.025 inch in diameter. The purpose of this double pinhole is to produce a fine pencil of parallel rays, which then pass through the specimen (not shown) of rubber, usually stretched, placed just beyond the pinhole farthest from the x-ray tube. Then at a fixed distance from the specimen is the photographic film in the holder or cassette shown in the photograph. If a Philips tube instead of the General Electric tube is arranged in this fashion, it is possible to make four photographs simultaneously.

The top of one of these multiple units with various types of cameras in position is shown in Figure 5. Five of these units are in continuous operation at the University of Illinois. The high tension transformer is enclosed in a grounded case below the table, with the control panel mounted on this case. The upper or target end of the tube is also grounded so that the experimenter is adequately protected against electric shock and against undue exposure to the x-rays.

Most of the results to be reported in these papers are concerned with rubber specimens, which are stretched to varying degrees of elongation. For this purpose a regular dumb-bell specimen may be clamped in a very simple device (Figure 6), such that the jaws may be moved apart, as in familiar tensile testing equipment, and fixed in position to hold the stretched rubber. This stretching device may be calibrated to measure elongation; or the measured separation of two fine ink lines ruled on the specimen itself, before stretching, gives the percentage elongation at which a given x-ray pattern is photographed.

The purpose of the nickel foil (Figure 3), is first of all to filter the x-ray beam from the copper target tube, so that practically speaking the ray which gets through will be monochromatic; that is, have a single wavelength, thus greatly simplifying the interpretation of the photographic pattern. For such a purpose the nickel foil is usually placed next to the film, next to the tube, or over the pinhole nearest the tube. In the position shown in Figure 3, over the outer pinhole, the nickel also registers a pattern on the film along with that of the rubber; thus the nickel pattern serves as a standard of intensity which is particularly important when it is desired to measure such intensities from the blackening of the photographic film (for example, the changing effects produced by stretching rubber over intervals of 25 per cent).

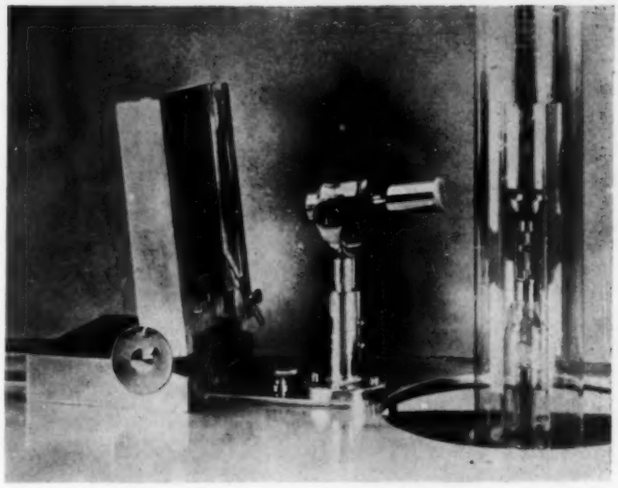


Figure 4. Arrangement of General Electric x-ray tube, collimating tube with pin holes, and film employed in the rubber studies (sample not shown).

For the quantitative measurement of the blackening, or the intensity of the x-ray beam striking the film at any particular spot, there are available instruments known as microphotometers. A beam of light of constant intensity passes through the developed film as it is slowly moved across the aperture. The emerging light falls upon a photoelectric cell, the resulting current is amplified, and finally produces registration on a moving roll of paper of a curve which plots the photographic density as a function of the travel of the film.

Such are the actual tools which we use in the study of rubber structures.

4. How are X-rays Diffracted by Crystals and Stretched Rubber?

In section 1 we saw that diffraction is one of the fundamental phenomena associated with light, and that this peculiar deflecting effect is detected at edges, fine slits, or ruled gratings acting in a sense as obstacles around which light waves curl. Long ago Fresnel, Young and others found the resulting alternate light and dark, or colored fringes. The very best effects with ordinary light are obtained by ruling parallel lines very close together on speculum metal. The ruled lines are, therefore, opaque compared with the bright spaces between them; so that from these reflecting, narrow, parallel areas incident light is reflected and diffracted. In other gratings on glass, the light may be transmitted as through many fine slits. A sunbeam is spread out into a rainbow of colors, its spectrum. The light from a mercury arc becomes a spectrum of some violet, blue and green lines.

Try as hard as they might, Roentgen and his con-

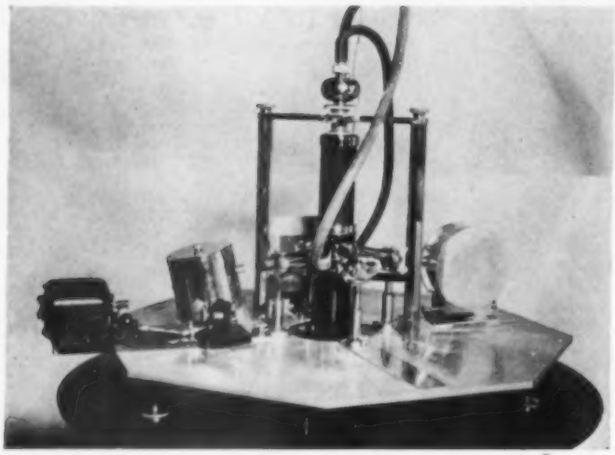


Figure 5. Table top of a multiple diffraction unit showing Philips tube and three types of film cameras as follows: right, cylindrical powder camera; back center, flat film holder; left, camera for rotating crystal, with motor.

temporaries could find no diffraction of x-rays in good optical gratings. Is the best grating too coarse for x-ray wavelengths, they asked? Today we know how to use ordinary optical gratings to diffract x-rays: it did not occur to these early workers to allow the x-ray beam to fall upon the grating at an *extremely* small grazing angle of incidence; for this was the secret unknown from 1895 to 1921. With all the efforts immediately following 1895 it began to look as if no grating could ever be ruled by man with lines close enough together so that the diffraction of x-rays could be detected—if they were of such nature that diffraction might occur under any condition whatever.

Then like a meteor on a dark night, came the astounding announcement by von Laue in 1912 that we are fairly deluged with perfect diffraction gratings for x-rays, not ruled by machines but built by nature from atoms and molecules in orderly, three-dimensional array—all crystals. Soon afterward the simple diffraction law connecting wavelength, angle of incidence and the grating spacing, was enunciated by Sir William Bragg and his son, Professor W. L. Bragg, which is the foundation stone of a great and fascinating branch of x-ray science.

The derivation of Bragg's Law involves only simple trigonometry, as any reader interested in mathematics may see for himself from Figure 7. The small circles represent the atoms of a crystal. Reflection at the angle θ occurs at each of the millions of planes, each reflected ray being retarded more than the one next above it by the distance ABC. For reinforcement, whereby the beams reflected from successive planes will add constructively together, crest and crest, and trough on trough, this retardation must equal an integral number of wavelengths: that is ABC must equal $n\lambda$. But ABC = $2d \sin\theta$. Therefore for reinforcement $2d \sin \theta = n\lambda$ (Bragg's Law); where n is an integer, λ is the x-ray wavelength, d is the grating spacing in the crystal, and θ is the angle of incidence of the x-ray beam on the grating. If the angle θ is such that the retardation does not equal $n\lambda$ then destructive interference occurs between rays from various planes, and no diffracted ray is observable.

Figure 6. Stretching device for rubber sample.

Now a crystal may be so arranged that diffraction takes place from only one set of parallel planes, or so that diffraction may take place simultaneously from many of the sets of planes which may be drawn in imagination in every direction through the crystal. Every single chemical element or compound in solid crystalline form is built on a different plan, on a lattice work which is characteristic of that one particular individual substance. Thus each one of these crystals will diffract x-rays in a manner which is just as characteristic of the crystal as a "fingerprint" is characteristic of each human being. The diffraction pattern is a direct clue to the ultimate architecture of the crystal.

Starting with the Bragg law, therefore, this plan of building is deduced from the *crystal spectrum*. With our eyes we may behold the outer form of a calcite crystal rhomb with its parallel faces and characteristic interfacial angles (Figure 8). From the x-ray diffraction pattern we find in the ultimate unit rhomb the arrangement of calcium, carbon and oxygen atoms (Figure 9). The indefinite multiplication of this unit cell in all directions finally builds up the crystal which we hold in our hands. It is not difficult to imagine that between these parallel faces so perfectly formed, the whole matter of the calcite must be built on a beautifully ordered space lattice, by which the penetrating x-rays are diffracted because the lattice spacings have magnitudes comparable with x-ray wavelengths. Even if the crystal faces were broken or imperfectly formed, still might the internal diffracting lattice persist. Even if the crystal were so small that it was merely a grain in a fine powder, with no microscopically detectable faces, still might it serve as a grating for x-rays—and so it actually does in collaboration with millions of other grains to produce a powder diffraction pattern.

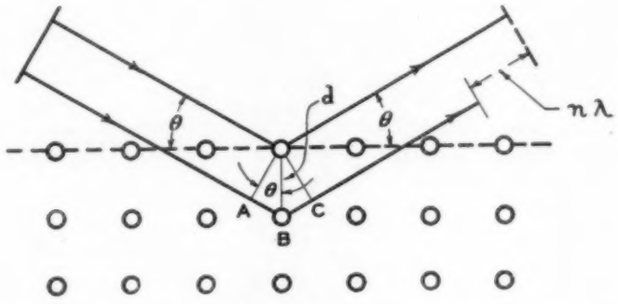


Figure 7. Diffraction of x-rays from parallel rows of atoms of a crystal. Bragg's Law may readily be derived from this sketch.

And so may we now classify many materials crystalline, which were formerly called amorphous, because there was no microscopic evidence of outer regular

form. Gilders whiting, for example, is considered amorphous by rubber compounders; yet x-rays show that it has the same internal space lattice structure as calcite.

But what shall we say of rubber? No one would have thought of classifying even stretched rubber as crystalline, even though it could be frozen in liquid air and then shattered into a multitude of fibers much like crystalline asbestos fibers. In the unstretched condition at ordinary temperatures rubber behaves even towards x-rays as a liquid, so that it *is* amorphous. But, after stretching, an amazing change has taken place; for above certain elongations a diffraction pattern is obtained which is just as rich and just as definitely indicative of a diffraction grating as any obtained from any true crystal with truly developed faces. Actually the pattern is not that of a single crystal but of a fiber, like that produced by drawing a metal through a die into a fine wire, in which there are a multitude of small individual crystals, but all oriented in exactly the same way with respect to the direction of drawing or stretching.

Thus entirely independently of any theory as to just what rubber is, how its molecule is constructed, or why it is elastic, it is a simple fact, proved by x-rays, that stretching pulls into organized parallel arrangement on a definite, three dimensional lattice plan certain structural units in rubber, which in the unstretched state were in disorder, and therefore in that state could not act as a diffraction grating. It is still more remarkable that this diffraction grating instantly disappears when the stretching force is released. If we retain the words "crystal" and "crystalline" in the classical sense to indicate permanently formed solid bodies with planar bounding faces, then we cannot accurately call stretched rubber "crystalline"; but we can still safely speak of an internal organized diffracting, space lattice structure for the giant polymer molecules, or sub-units of these. Crystals of rubber formed at low temperatures may be safely designated as such.

And just as we constructed the model of the ultimate crystalline unit of calcite directly from the interpretations of the x-ray diffraction pattern, so we may construct a model of the unit space lattice cell of stretched rubber. Such a model of the rubber unit cell is now being built and will be reproduced it is hoped in a future issue. The structure of this rubber unit is unfortunately a bit too complex for reproduction as a drawing.

Figure 8. Calcite crystal.

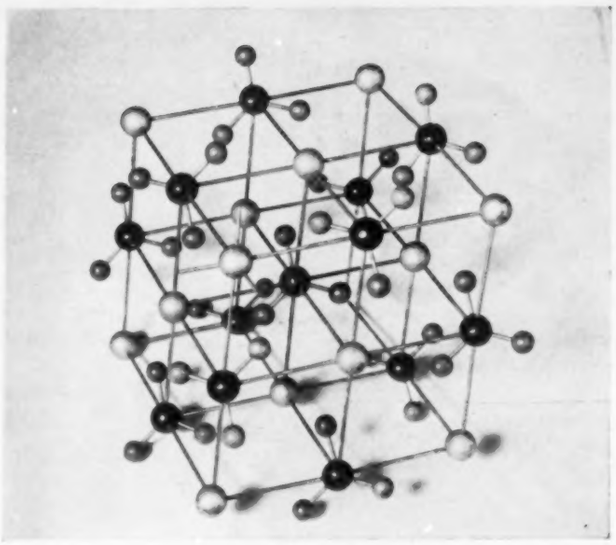


Figure 9. Space lattice model of a calcite crystal. The large, shiny spheres represent calcium atoms, the large black spheres represent carbon atoms, and the groups of three small spheres each represent oxygen atoms.

There is one fundamental difference between the calcite and the rubber unit cells. The former contains an integral number of simple $CaCO_3$ molecules. The latter contains not whole rubber molecules, for these are very long, but only an integral number (8) of the simple C_5H_8 or isoprene units. These isoprene units are links in the long, parallel chains comprising the whole hydrocarbon molecule. X-rays show that just two links, with a combined length of 8.20 Ångstrom units, lie along that direction of the tiny cell which is parallel to the direction of stretching. Thus once for all we know just what the ultimate unit of organization is in rubber which has been adequately stretched so that ordered molecular alignment is produced.

Obviously, rubber, complex as it is, can be treated and compounded in a multitude of ways: and it is reasonable to assume that depending on previous history there may be wide variations in the critical elongation above which the organized diffracting lattice appears; it is even conceivable that rubber may be treated so that the characteristic pattern never does appear at any elongation. Here then is an excellent method of evaluating the ultimate effects of mechanical and chemical treatment on the behavior of rubber.

In a technical paper already published in *Industrial and Engineering Chemistry* (November 1940), a correlation has been established, for example, between stress-strain behavior, resilience and the effects of stretching and retraction of rubber in the sense of establishment and retention of the organized molecular structure. In later papers the effects of fillers, vulcanizing agents, accelerators, and of other factors will be considered as they are discovered from the diffraction patterns.

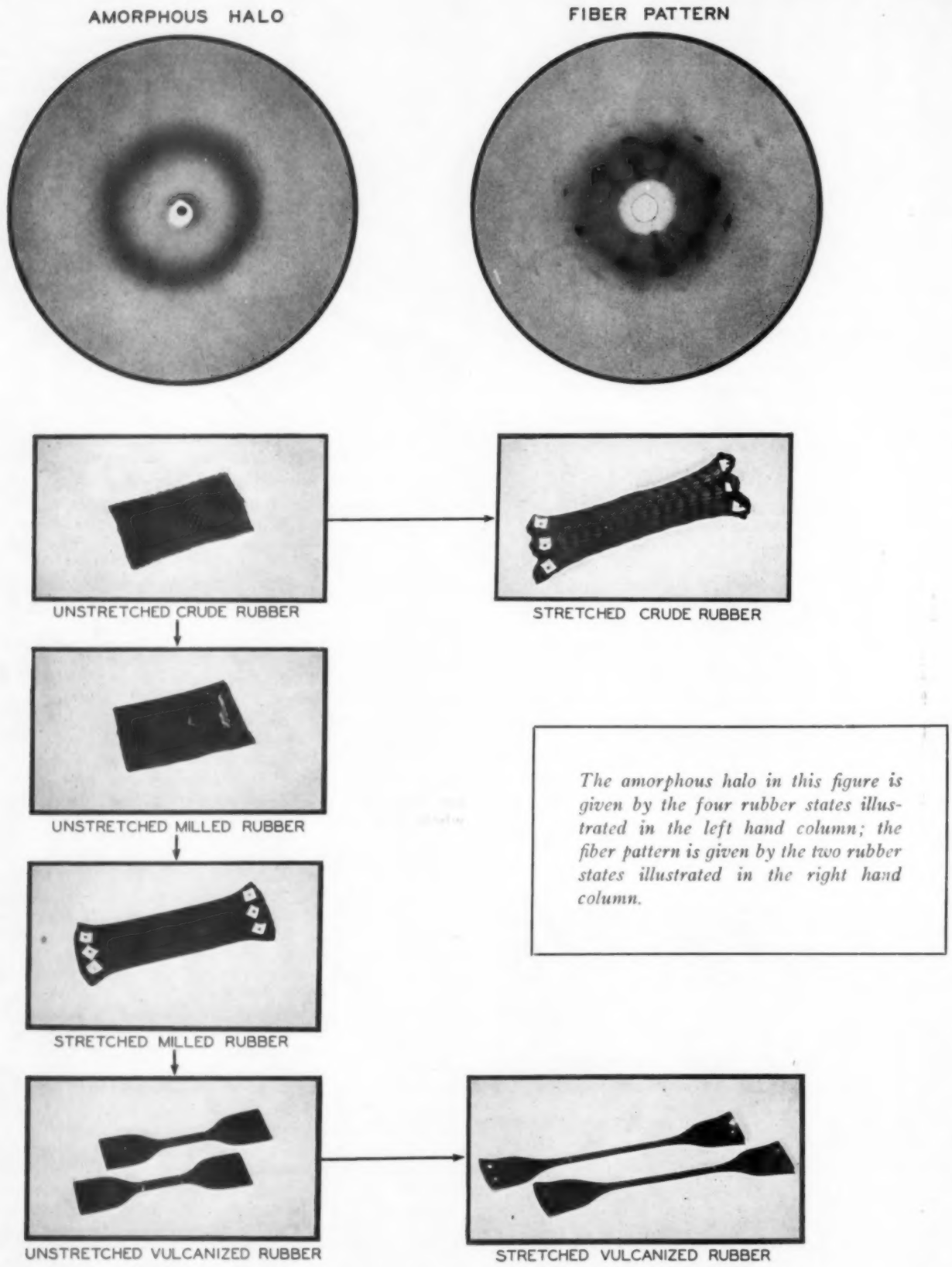

AMORPHOUS HALO
FIBER PATTERN
UNSTRETCHED CRUDE RUBBER
STRETCHED CRUDE RUBBER
UNSTRETCHED MILLED RUBBER
STRETCHED MILLED RUBBER
UNSTRETCHED VULCANIZED RUBBER
STRETCHED VULCANIZED RUBBER
The amorphous halo in this figure is given by the four rubber states illustrated in the left hand column; the fiber pattern is given by the two rubber states illustrated in the right hand column.

Figure 10. Tabular classification of various rubber states which give the two characteristic x-ray diffraction patterns

5. What are the Typical Diffraction Patterns of Rubber?

As already indicated, unstretched crude rubber such as crepe or smoked sheet gives a liquid or "amorphous" type of diffraction pattern consisting of a single broad halo. Upon stretching beyond 75 to 100 per cent elongation, this crude rubber produces the characteristic fiber pattern indicative of the diffraction lattice arrangement. When crude rubber is milled, the same amorphous halo is observed, not only before stretching, *but even after stretching*, even to maximum elongation if the milling has been thorough.

Thus this mechanical treatment, which is known to lower the molecular weight markedly, very evidently so effectively chops up the molecules, or in other words depolymerizes the material, that no longer can the requisite parallel alignment of the molecular chains be effected by stretching. One of the mysteries which has confronted both the rubber compounder and the x-ray analyst has been the actual nature of vulcanization.

The amorphous halo pattern of unstretched vulcanized rubber is indistinguishable from that of unstretched crude or milled rubber, and no extraneous effects due to sulphur are detectable. Stretched milled rubber gives no fiber patterns, but *immediately upon vulcanization*, the specimen sufficiently stretched gives again identically the same fiber pattern as stretched crube rubber does. The only difference in behavior is that the vulcanized sample must be stretched two or three times as far before this sharp pattern appears.

This is a clue then to the real function of vulcanization—namely that this treatment restores the ability, lost during milling, of rubber molecules to line up into a real lattice grating when the sample is stretched. Exactly the same unit cell with exactly the same dimensions is derived from the pattern, so that the sulfur atoms evidently find room to fit into available open spaces in the lattice work of the rubber hydrocarbon. We may summarize the rubber diffraction patterns typical for ordinary samples at ordinary temperatures in Figure 10 *(2)*. The only other type of pattern ever observed is that for frozen, or truly crystallized rubber.

Thus we conclude this first article, which has been designed to present as nearly as possible in familiar language the fundamentals of x-ray science applied to a familiar but still truly remarkable material—natural rubber.

(2) The patterns were reproduced by first making contact negatives from the original films. The concentric circles registered on the original films by the nickel foil are not shown.

Polyvinyl Acetate Thermoplastic Resins

THE polyvinyl acetates offered by the R. & H. Chemicals Department of E. I. du Pont de Nemours & Co., Inc., Wilmington, Delaware, are described by the company as an interesting group of thermoplastic resins. They are colorless, glass-clear, tasteless, odorless, low density, slow burning products. They are said to have definite advantages over many natural resins with somewhat similar properties because of greater uniformity, freedom from impurities, and wide compatibility with a variety of materials.

Polyvinyl acetate emulsions may be readily diluted with the most economical solvent, water, to any desired concentration; they are miscible with rubber latex, starch, and wax emulsions. The emulsions are not precipitated by small amounts of dilute acids and alkalis. They may be coagulated by the addition of aluminum sulphate, followed by the addition of aqueous ammonia: for example, to 100 parts of a 5% solids content emulsion, add 10 parts by volume of a 3% solution of aluminum sulphate, then add sufficient aqueous ammonia to adjust the pH to 8.0.

Polyvinyl acetate solid, solution or emulsion may be used as an adhesive for joining textiles, paper, cork, leather, metal, wood, and glass. The solid may be distributed over the surfaces, or the surfaces may be coated with solution or emulsion and allowed to dry. The treated surfaces are then joined by the application of heat and pressure.

For special applications, the adhesive properties of polyvinyl acetate may be improved by the addition of other materials. For joining leather to metal, the addition of 6-40% of rubber latex to the emulsion type (per cent rubber based on solid polyvinyl acetate content) is especially recommended. In this case, a plasticizer should not be used, and it is important that the surface of the metal be free from grease and oil. In preparing the mixture, the polyvinyl acetate emulsion is made slightly alkaline to litmus with aqueous ammonia or ethanolamine prior to mixing with the rubber latex. Mixtures of the emulsions with starch or other adhesives exhibit interesting properties.

Rubber-Glo—A New Mold Lubricant

A NEW non-toxic, non-tacky, odorless liquid for use in the rubber industry as a mold and mandrel lubricant has been introduced under the name of Rubber-Glo by the Norris Manufacturing Co., 318 Atlantic Street, Paterson, N. J. The new lubricant, according to the manufacturers, facilitates the removal of cured rubber from molds, has a satin-like finish, and does not build up on the mold. It is said to give the same results at every heat.

As a general mold lubricant, the company recommends the concentrate form of Rubber-Glo, with approximately seven parts or more of water to one part of the material. The solution may be applied by spraying lightly on the hot mold. The concentrated form is also recommended for lubricating the mandrels used in open steam wrapped cures. It may be either sprayed or swabbed in this connection. A special type of Rubber-Glo is offered for application to cold mandrels.

Improvement in Handling Acids in Steel Pickling Operations

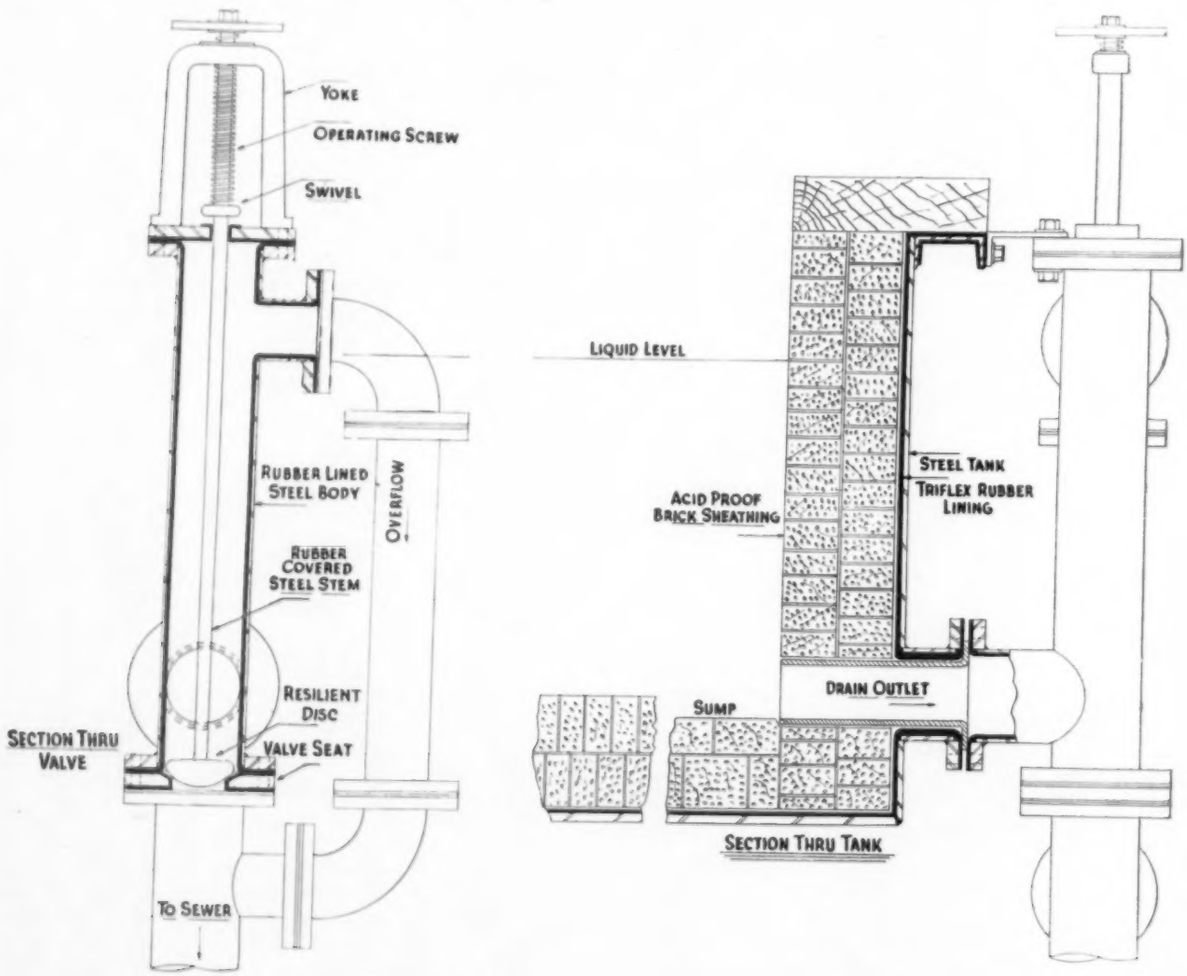
FURTHER improvement in the method of handling acids used in steel pickling operations is announced by the B. F. Goodrich Company, Akron, Ohio, as a result of its development of a new combination outlet and overflow valve for these tanks. The new product is a modification of the patented rubber-lined Vulcalock valve developed by Goodrich for handling corrosive and abrasive fluids, and is covered by U. S. Patent No. 1,947,257.

Installed entirely on the outside of the tank, the outlet and overflow installation uses a wheel and screw attached to the valve stem to raise and lower the valve disc. It can be fitted to existing pickling tanks, or built into the construction of new ones. Provision is made for automatic overflow at a predetermined level, thus maintaining constant liquid level in the tank.

Among the principal advantages of the new method is the ease and rapidity with which the valve can be operated and the solutions completely drained from the tank, any accumulated sludge being carried away rapidly and completely, with a minimum of flushing.

Previous methods used have been siphoning, or discharge through a removable drain plug installed in the tank's bottom. With a siphon, much labor with hose and shovel was required to remove the sludge. In the second system the drain plug often proved an obstruction which was caught and jarred loose by the steel being handled in the pickling vat, with resultant loss of acid.

The new valve, completely rubber lined, is fitted with a low-cost replaceable, resilient, rounded disc which snaps over a circular plate at the lower end of the stem and provides an absolute seal when brought into contact with the rubber-covered seat ring.



Over-all layout of the new combination outlet and overflow valve for steel pickling tanks.

Editorials . . . . . .

Rubber Supplies

THE announcement that the International Rubber Regulation Committee would meet in London later this month to set the quota figure for the second quarter of 1941, failed to rouse more than casual comment in both domestic rubber dealing and manufacturing circles. It is taken for granted that the quota will be maintained at 100%, and there is even a possibility that it may be set at over the 100% figure, if such a move holds promise of expediting the accumulation of stockpiles of rubber in the United States, and England as well.

But, as has been stated in these columns before, the question facing the industry is not one concerned with higher permissible shipments under raised quotas, but of the ability of rubber estates to keep step with the increased quotas. The question of whether sufficient shipping space will be available to transport larger quantities of rubber to this and other countries is another which must receive serious consideration.

A glance at the record for 1940 reveals that shipments outpaced permissible quotas. "Net Exports" for all countries participating in the regulation scheme, with the exception of Thailand and French Indo-China, amounted to 1,256,681 long tons, according to the Regulation Committee's figures, as compared with permissible exports of 1,244,734. Thus, it seems evident that participating countries had no difficulty in meeting quotas. But a closer look reveals that in the fourth quarter of the year, during which a 90% quota was in effect, net exports dropped some 18,000 long tons behind permissible shipments.

It is true that in certain months of last year net exports were considerably higher than permissible shipments. But the trend in recent months under higher quotas indicates the advisability of awaiting the figures for the first quarter of 1941 before any real opinions may be reached concerning the ability of the rubber producers to meet a 100% quota.

As for the shipping problem, it now seems evident that Congress will approve all-out aid to Britain, which will probably include the use of the American Merchant Marine to move American goods direct to England. Since most of the rubber from the East is now carried in American bottoms, it is quite possible that if such action is taken the available shipping space for rubber may not remain large enough to keep arrivals in the United States at the current large rate.

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Rubber in the Western Hemisphere

WITHIN the next few months the reports of the five survey parties sent to different parts of Latin America to determine the possibilities of crude rubber cultivation in the Western Hemisphere will be in the hands of the Department of Agriculture, which is aggressively pursuing a careful policy of selecting proper sites and locales under the special $500,000 appropriation made for the purpose by Congress last June. The first survey party has already returned and has made a preliminary report.

Although it is far too early to judge the results of these survey parties, it is evident from the preliminary report of the one headed by Dr. E. C. Stakeman that the Latin American countries are very much interested in the possibilities. The governments of several countries have already made appropriations and formulated plans to encourage the planting of rubber by domestic agriculturists. Efficient cooperation, combined with the practical experience offered to individual growers by the Department of Agriculture, is certain to show positive results within the next decade.

CURRENT NEWS OF THE MONTH

1939 CONSUMPTION OF RUBBER REPORTED BY CENSUS BUREAU

Rubber consumed by establishments in the rubber products industries of the United States in 1939 amounted to 714,627 long tons, according to totals just released from the Census of Manufactures by Director William Lane Austin of the Bureau of the Census.

Crude rubber consumed totalled 563,710 tons, valued at $201,866,370. The rubber tires and inner tubes industry consumed 442,668 tons of crude rubber, valued at $157,640,126; the rubber boots and shoes industry, 19,133 tons, valued at $7,102,709; and the miscellaneous rubber goods industries, 101,909 tons, valued at $37,123,535.

Reclaimed rubber consumed totalled 150,917 tons. Of this, 101,890 tons, valued at $12,904,222, was purchased, 45,979 tons ($5,784,041) for use in the rubber tires and inner tubes industry, 53,709 tons ($6,857,829) for use in the miscellaneous rubber products establishments, and 2,202 tons ($262,352) in the rubber boots and shoes industry. Rubber reclaimed and consumed by the same establishments amounted to 49,027 tons of which 25,498 tons were used in rubber tires and inner tubes, and 23,529 tons in miscellaneous rubber products establishments.

Divided by Class of Products

Crude rubber consumption, by class of products made, was divided as follows: 357,221 tons, pneumatic casings; 51,731 tons, inner tubes; 1,570 tons, solid and cushion tires; 15,970 tons, boots and shoes; 22,642 tons, rubber heels and soles, including slab soling; 9,291 tons, finished rubberized fabrics and rubberized clothing, including bathing caps and bathing suits; 47,472 tons, mechanical rubber goods, rubber flooring, rubber mats and matting; 3,328 tons, hard rubber goods; 9,296 tons, rubber thread, rubber cement, rubber gloves; 16,973 tons, tire sundries and repair materials, rebuilt or retreaded tires, including camelback; and 28,216 tons in other manufactures of rubber, including druggists' and medical sundries, balloons, stationers' rubber bands, erasers, golf and tennis balls, toys, and sponge rubber products. These statistics do not include rubber consumed by establishments classified in other industries, such as the wire, electrical, textile, etc., industries for which no data are collected.

Ohio continued to lead all states in the amount of rubber consumed with 189,835 tons of crude rubber and 47,505 tons of reclaimed rubber. Michigan ranked second with a consumption of 85,848 tons of crude and 19,834 tons of reclaimed rubber. Massachusetts was third with a total of 42,417 tons of crude and 16,519 tons of reclaimed rubber consumed, and California fourth with a consumption of 47,494 tons of crude and 8,275 tons of reclaimed rubber.

For other states, whose consumption of crude rubber was listed individually, total tonnages were: Pennsylvania, 24,824; New York, 22,506; Connecticut, 18,828; Indiana, 16,754; New Jersey, 14,021; Missouri, 9,552; Rhode Island, 7,453; and Illinois, 6,311.

Rainy-Day Writing Paper

Waterproof paper, on which it is possible to write even in pouring rain, can be prepared by treating the paper with a mixture of latex, finely powdered glass, and a creaming agent, according to a report from Buitenzorg, Java, appearing in a recent issue of *U. S. Industrial Chemical News*. While the paper is not well adapted to ink, it can be easily written on with pencil and can be used for printing or typing, says the report.

Rubber Factory for Cuba

A new rubber goods factory is being established in Matanzas, Cuba, for the production of tennis shoes, heels, rubberized cloth, and other products. A two-story building has been provided to Michael Schrage, formerly engaged in rubber manufacturing in Poland, and machinery and equipment, imported from the United States, is being installed. The factory, which is expected to be in operation by next May, will eventually undertake the production of tires and tubes.

Mimex Upheld in Court Decision

In the suit of the United States Rubber Company and the Dewey and Almy Chemical Company against Mimex, Inc., of Long Island City, N. Y., alleging infringement of U. S. Patents Nos. 1,582,219 and 1,765,134, covering latex can sealing compounds, Judge Galston, in the Court of First Jurisdiction, handed down a decision on January 30 in favor of Mimex, holding that the patents were invalid. It is understood that the decision will be appealed.

SCHADE SEES UNLIMITED RANGE FOR NEWER SYNTHETIC RUBBERS

The manufacture of several new varieties of synthetic rubber, made from as yet untried combinations of raw materials and hand-tailored to bring out desirable characteristics as yet unobtained, was predicted by James W. Schade, director of research of the B. F. Goodrich Co., in a paper on the chemistry of rubber and synthetic rubber, delivered before the Institute of the Aeronautical Sciences at the Biltmore Hotel in New York City on January 30.

"If this expectation is realized, the usefulness of rubber-like materials will spread far beyond the limits imposed by the properties of materials now available," Mr. Schade said. He disclosed that synthetic rubber is now being applied to airplane de-icers, aviation and gasoline hose and in other mechanical parts throughout industry where special resistance to oils, acids and oxidation is needed.

Discusses Comparative Properties

A glimpse of "the picture as it stands today" with respect to comparative properties of natural and synthetic rubbers was given by Mr. Schade. He pointed out that natural rubber is still one of the best all-around engineering materials known to man—as evidenced by the increase in average auto tire mileage from 3,000 to better than 15,000, and by rubber's industrial use in some cases at temperatures only slightly below "red heat."

Yet already, he said, synthetics are far superior to the natural product in resisting certain deteriorating influences often encountered in service. These are (1) resistance to swelling and deterioration in contact with oils, organic solvents and water, (2) to cracking in sunlight, (3) to deterioration by heat, (4) resistance to powerful oxidizing agents, and (5) to diffusion of gases. Natural rubber is still superior to all synthetics now available in (1) elasticity and rebound, (2) low heat generation through hysteresis, or internal friction, (3) extensibility, and (4) resistance to stiffening at low temperatures.

"This is the picture today," Mr. Schade said. "How it will be changed within the next few years or even the next few months no one can safely predict."

An interesting sidelight was that Dr. William C. Geer, who developed the rubber De-Icer in the Goodrich laboratories, presided at the symposium.

RUBBER IN NATIONAL DEFENSE STRESSED BY COLLYER IN TALKS

The role of the rubber industry in national defense was the theme of a series of special regional conferences held in six key marketing areas by the B. F. Goodrich Company last month. John L. Collyer, president, was the principal speaker at the conferences held at New York, Chicago and Cleveland.

America's ability to attain self-sufficiency in the vital material—rubber—is dependent upon the speed with which the United States creates productive capacity for the new synthetic materials, Mr. Collyer told his field organization. He spoke optimistically of the 1941 outlook for business in the rubber industry, but warned, "The real key to the industry's ability to meet the increased demands for consumer goods and national defense orders, lies in maintaining an uninterrupted flow of basic raw materials used in the manufacture of rubber goods.

"The rubber industry already is feeling the effects of our national defense program," the rubber executive said. "During the past six months direct government orders totaling millions of dollars were placed in the rubber industry, more than $10,000,000 worth being placed with the B. F. Goodrich Company alone. "More such orders are to come," he said, "and it is expected that deliveries on these government contracts will become substantial during the early months of this year."

While the rubber industry, Mr. Collyer said, has ample productive capacity, in most instances, to keep abreast of the anticipated increased demand without the need of priorities, at least for some time to come, the question of unfailing supplies of rubber must be faced.

Productive Capacity Needed

"Because of our dependence on the Far East for fully 97% of our crude rubber requirements, every step must be taken to insure that no crisis in that part of the world affecting this customary supply may interfere with the carrying out of our national defense program," he said. "Our ability to attain self-sufficiency in terms of rubber is dependent on the speed with which the United States creates productive capacity for the new synthetic materials."

"Meantime, by the end of 1941, if the present rate of shipments is not interrupted, this country, due to the foresight of our government and the cooperation of the rubber industry, will have stockpiles of natural rubber equivalent to more than a year's requirements, when added to manufacturers' inventories," Mr. Collyer estimated.

He expressed the opinion, to the sales groups, that in the event of an emergency the use of crude rubber would have to be restricted and larger amounts of reclaimed rubber used.

"These steps would have to be taken," he said, "to tide us over the period that would be required to establish large capacity for the production of synthetic rubber. Our estimate, based upon the experience we have gained in developing and manufacturing our own synthetic rubber, Ameripol, is that from 18 to 24 months would be required for the creation of such a standby industry."

In the field of national defense he revealed that orders are being filled by his company for De-Icing equipment for airplanes, rubber tracks for military tanks and scout cars, self-sealing fuel tanks for combat planes, pneumatic tires of all kinds, as well as a multitude of mechanical goods items such as vibro-insulators, belting and hose, destined not only for military use but also to other industrial plants engaged in filling defense contracts.

On the domestic business scene Mr. Collyer expects some increase in total tire sales in 1941, principally in the replacement market which is expected to absorb an estimated 37,000,000 units, nearly two million more than in 1940.

Coming Events

Feb. 20. Canadian Rubber Group, Chemistry Building, University of Toronto, Toronto, Canada.

Feb. 28. Buffalo Rubber Group, Hotel Lenox, Buffalo, N. Y.

Mar. 3-7. A.S.T.M. Committee Week, Hotel Mayflower, Washington, D. C.

Mar. 4. Los Angeles Rubber Group, Hotel Mayfair, Los Angeles, Cal.

Mar. 17-19. Annual Meeting, N.A.W.M.D., Hotel Sherman, Chicago, Ill.

Mar. 21. New York Rubber Group, Building Trades Club, New York City.

Mar. 28. Boston Rubber Group, University Club, Boston, Mass.

Mar. 31-Apr. 3. Spring Meeting, A.S.M.E., Atlanta, Ga.

Apr. 10-11. Rubber Division, A.C.S., Mayfair Hotel, St. Louis, Mo.

June 16-20. Semi-annual Meeting, A.S.M.E., Kansas City, Mo.

June 23-27. A.S.T.M. Annual Meeting, Palmer House, Chicago, Ill.

Sept. 8-12. American Chemical Society, 102nd Meeting, Atlantic City, N. J.

Amthor Moves to Own Factory

The Amthor Testing Instrument Co., Inc., makers of abrasion and tensile testing instruments for the rubber and other industries, has moved into its own two-story factory building at 45-53 Van Sinderen Avenue in Brooklyn, N. Y. The new quarters provide increased manufacturing and office space.

SYNTHETIC RUBBER EXPANSION SOUGHT BY GOVERNMENT GROUP

According to reliable sources in Washington, D. C., plans for the production of synthetic rubber in the United States to the extent of as much as 150,000 tons a year are being formulated by the Rubber Reserve Company, organized by the Reconstruction Finance Corporation to acquire a stockpile of crude rubber and to aid the defense program in any possible manner or form. The plans, it is understood, call for cooperation from leading companies in the rubber, chemical and petroleum fields.

Principal companies believed to be involved in present conferences with officials of the Rubber Reserve organization include Goodyear, Goodrich, Firestone, U. S. Rubber, DuPont, Standard Oil, Phillips Petroleum and the Shell Union Oil Corporation. The latter concern is said to be planning the construction of a plant at Deer Park, Texas, near Houston, for the production of butadiene. The conferences, however, are believed designed to bring many additional companies into the range of potential producers of synthetic rubber or rubber substitutes.

The Reconstruction Finance Corporation, it is understood, has requested full proposals from petroleum and other companies for the construction of plants for the manufacture of synthetic rubber or necessary ingredients which call for government loans. These loans, it is expected, may amount to as much as $50,000,000. No definite loan commitments have been made, however, since the R.F.C. favors a policy of private plant construction. If plans for the latter move do not provide for sufficient synthetic rubber production, then the loans will probably be promptly issued.

Officials of the R.F.C. have admitted that there are many obstacles to its plans, the principal one being that several concerns owning patents which may be valuable in the undertaking are loathe to apply for the loans offered by the government. It is presumed that the R.F.C. favors patent-pooling to an extent necessary to provide for sufficient production of synthetic rubber to supply the United States in the event of an emergency, providing sources of supply of crude rubber are severely hampered or cut off.

New York Group to Meet

The next meeting of the New York Group, Rubber Division, A.C.S., will be held on Friday, March 21, at the Building Trades Club, 2 Park Ave., New York City. A tentative program was arranged by the Executive Committee of the Group, which met in New York on February 5. The Committee also selected June 6 as a tentative date for the annual outing and voted the continuance of the annual Paper Essay Contest. Further details on the next meeting, the outing and the paper contest will be made available shortly.

DEVELOPMENT OF CRUDE RUBBER ACTIVITIES IN WESTERN HEMISPHERE CONTINUES AT ACTIVE PACE AS FIRST SURVEY PARTY MAKES REPORT

In an address before the 29th Annual Farm and Home Convention, held at the University of Kentucky, Lexington, Kentucky, on January 31, L. A. Wheeler, Director of the Office of Foreign Agricultural Relations of the Department of Agriculture, discussed the importance of developing efficient sources of supply of certain agricultural products in the Western Hemisphere. The Tropics of this hemisphere, he said, possess latent resources capable of producing all of them.

Referring to rubber, Mr. Wheeler mentioned the fact that Congress had appropriated $500,000 in June, 1940, for the Department of Agriculture for use in exploring the possibilities for rubber production in the Western Hemisphere and for experimental work leading toward the commercial production of rubber in Tropical America, and that under this authorization the Bureau of Plant Industry of the Department sent five survey parties to various parts of Latin America. Reports on these surveys, he said, would be made within the near future.

While these surveys have been going forward, he continued, plans have been worked out for the establishment of experiment stations for rubber production at strategic points in Latin America. These experiment stations will be supplied with high-yielding strains of rubber by the Department of Agriculture. The next step will be the distribution of planting stock to organizations and individuals who are prepared to undertake commercial rubber cultivation.

In concluding his discussion on the rubber phase, Mr. Wheeler emphasized the point that the Department of Agriculture is receiving excellent cooperation from the governments of countries in which rubber production may be possible. These governments, he said, have supplied personnel and funds in connection with the rubber surveys and the establishment of experimental stations. The Department has also received splendid cooperation from American concerns which are interested in establishing the cultivation of rubber on an extensive scale in the Western Hemisphere.

One Survey Party Reports

Early this month, one of the survey parties mentioned by Mr. Wheeler in his address, which was headed by Dr. E. C. Stakeman of the University of Minnesota, returned to Washington from a five-month survey in Latin American countries. According to Dr. Stakeman, the party had located areas in Peru, Colombia and Ecuador suitable for the commercial cultivation of rubber. Based on the preliminary report of the survey party, the Department of Agriculture announced that it would act on its recommendation to establish four nurseries in these three countries for propagating Hevea rubber seedlings for distribution to farmers inclined toward cultivation of rubber. Government experts in Colombia have expressed the belief that the lower Cauca Valley, not very far south of Panama, and at present scantily developed, could become an important rubber producing area.

Seed Rushed to Brazil

According to a statement made by the Department of Agriculture on February 3, a ton of selected rubber seed was rushed to Brazil by means of three large Army bombers. The seed was collected from high-yielding clones grown in the Philippines, shipped to the Canal Zone, and flown from that point to Belem in Brazil. The Army was requested to fly the seed down because the next scheduled boat transportation would require another month or more and by such time much of the seed would have deteriorated and been worthless.

The shipment contained 204,000 seeds in all. It was destined for delivery to the Instituto Agronomico do Norte, which is cooperating with the Department of Agriculture and the Latin American republics in the rubber investigation. The seeds will be tested by the institute for resistance to the leaf blight disease which is prevalent in many parts of Latin America. Early in January, the Department of Agriculture shipped 100 budded stumps from high-yielding blight-resistant strains of rubber to the Institute.

Domestic rubber manufacturers in Brazil, incidentally, are understood to have requested the Brazilian government to clamp down on the exportation of crude rubber or at least enact a ruling that exports be made only after the government verifies the needs of the domestic manufacturers. The request was made after it was learned that Japanese ships were booked to carry heavy shipments of rubber purchased by Japan, presumably for delivery to Germany. Domestic demand for crude rubber in Brazil has been increasing annually in the past several years, the figure for the current year being estimated at 6,000 tons.

Nicaragua to Grow Rubber

On the recommendation of one of the survey parties sent out by the U. S. Department of Agriculture, two experimental stations will shortly be started on the Atlantic Coast of Nicaragua, according to General Jose Maria Zelaya, Minister of Agriculture, in a statement made at Managua on January 18. The purpose of the stations will of course be to ascertain if a good grade of rubber can be grown commercially in the country. The American experts are expected to return shortly to help organize the stations.

Developments are also reported from the Philippine Islands. According to the Secretary of Agriculture and Commerce, the project for the cultivation of rubber in Mindanao is making progress. The Agricultural and Industrial Bank, he revealed, had already approved loans to five concerns for financing the planting of rubber in Mindanao. Although the extent of these loans was not disclosed, it is understood that each concern would be required to raise a capital of 150,000 pesos (approximately $75,000) and that the bank would then loan each concern an equivalent amount.

Guayule Development Again Urged

In a statement made from Salinas, California, George H. Carnahan, president of the Intercontinental Rubber Co., on February 5, repeated his claims that strains of the guayule plant now being grown in the Salinas Valley could provide the United States with its own rubber. Revealing that one of the company's subsidiaries is now producing about 10,000 pounds of guayule daily, Mr. Carnahan said that although processing the plant costs more than imported rubber it "may be the answer to one of the American defense problems if war spreads to the Pacific." It was also stated that Italy, which has been experimenting with guayule for several years, has 105 drums of guayule seed stored in Salinas but has been unable to ship them because of the British blockade.

The Goodyear Tire & Rubber Company revealed early this month that the company is closely collaborating with the Department of Agriculture and has opened its experimental stations in Costa Rica and Panama for study by the survey parties.

Takes Over Gettysburg Plant

Operations conducted at its branch plant in Gettysburg, Penna., have been turned over by the O'Sullivan Rubber Company, Inc., to the Victor Products Corporation, and in the future certain branded merchandise heretofore manufactured and sold by O'Sullivan will be in the hands of the Victor concern. The move was made to enable O'Sullivan to concentrate on O'Sullivan-branded merchandise sold through shoe finding jobbers and to shoe manufacturers. O'Sullivan operates its main plant at Winchester, Virginia. Victor Products operates a reclaiming plant at Hagerstown, Maryland, the output of which is largely absorbed by O'Sullivan.

In view of the defense work undertaken by leading members of the automotive industry, the board of directors of the Automobile Manufacturers Association has cancelled the National Automobile Show which normally would have been held in New York City next October.

CANADIAN RUBBER GROUP HEARS SIBLEY OF MONSANTO

Dr. R. L. Sibley, director of research for the Rubber Service Department of the Monsanto Chemical Company, was the principal speaker at a meeting of the Ontario Rubber Section of the Canadian Chemical Association, held on January 23 at the University of Toronto, in Toronto, Canada.

Taking as his subject, "The Chemical Reaction of Rubber," Dr. Sibley reviewed the patent and other published literature on the reactions of rubber, other than those involved in vulcanization. He pointed out, early in his address, that while rubber offered the possibilities of the reactions of a typical olefin, the only one which had received much attention was that of rubber-sulfur. Before presenting details on the reported reactions, he emphasized the possibility that many of these reactions had not been carried to a final and valuable conclusion.

By heating alone some 23 hydrocarbons can be produced from rubber, according to Dr. Sibley, while the products resulting from oxidation and halogenation have proved of great interest. Chlorinated rubber and the cyclic rubbers were cited as having wide and diversified use. An experiment was mentioned in which rubber was reacted with increasing proportions of aqua regia to give a wide variety of products. It was pointed out that as the proportion of aqua regia was increased, the chlorine content showed a much greater tendency to increase than did the nitrogen content.

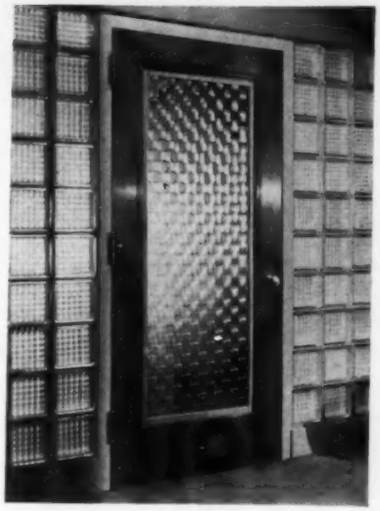
In summarizing, Dr. Sibley pointed out that under proper conditions rubber forms additional products with many substances such as sulfur, oxygen, ozone, hydrogen, the halogens, the hydrohalides, dithiocyanogen and dithioglycol, and forms substitution products with many other materials. Many of the reactions cited could be carried out on vulcanized rubber, according to the speaker.

An interesting discussion followed the talk, after which W. E. Campbell, of Gutta Percha & Rubber, Ltd., expressed the appreciation of the group in a vote of thanks to the speaker.

The next meeting of the group will be held on February 20, with dinner at the Hart House preceding the meeting in the Chemistry Building of the University of Toronto. Talks will be given by various members of the group, as follows: *Rubber Substitute as a Compounding Material,* O. B. Crowell (Viceroy Manufacturing); *Engineering and General Uses of a Pyrometer in a Rubber Factory,* C. L. Brittain and co-workers (Gutta Percha & Rubber); and *Some Recent Experiences in Britain,* L. A. G. Winter (Dunlop).

Ralph B. Symons, of the Canada Wire & Cable Co., Toronto, present secretary and treasurer of the group, will shortly become associated with the Firestone Rubber & Latex Products Co., at Fall River, Mass., and therefore it is suggested that all correspondence pertaining to the activities of the group be directed to the chairman, Norman S. Grace, c/o Dunlop Tire & Rubber Goods Co., Ltd., Toronto, until a new secretary-treasurer is appointed.

Koroseal Strips Form Door



One of the most effective product displays is the illustrated door which is made of laced strips of Koroseal, the Goodrich material which Comprehensive Fabrics, Inc., are merchandising through licensees. The door graces the organization's ultra modern showrooms in the Empire State Building in New York City.

Rubber Reclaimers Elect Officers

At the annual meeting of the Rubber Reclaimers Association, held at the Waldorf-Astoria in New York City on January 14, the following officers were elected: *President,* J. P. Coe (Naugatuck Chemical); *Vice-President,* E. H. Brooks (Goodyear); *Secretary-Treasurer,* Mrs. M. B. Miller. Directors now include Mr. Coe, Allyn I. Brandt (Philadelphia Rubber Works), J. F. McLean (Pequanoc), L. J. Plumb (U. S. Rubber Reclaiming), and H. S. Royce (Boston Woven Hose).

Dr. H. E. Howe, Editor of *Industrial & Engineering Chemistry,* was named Chemical Priority Executive of the Division of Priorities of the Office of Production Management, organized to foster the National Defense Program, on February 1. He will act as chairman of the Chemicals Priority Committee.

Robert E. Fulton, a member of the comptroller's staff of the Goodyear Tire & Rubber Co. at Akron for the past year, and previously associated with the Los Angeles office, has been appointed general auditor of the company. He has been with Goodyear since 1929.

LOS ANGELES MEETING SPONSORED BY KIRKHILL

The monthly supper meeting of the Los Angeles Group, Rubber Division, A.C.S., held at the Mayfair Hotel in Los Angeles on February 4, was attended by approximately 110 members and guests. The main speaker on the program, which was sponsored by the Kirkhill Rubber Co., was Ed Ainsworth, author of the book *Pot Luck,* a biography of Parker Lyon, founder of the Pony Express Museum in Pasadena. The talk was humorous in character.

A moving picture, dealing with the cultivation of rubber in the Netherlands East Indies, and one presenting leading news events of 1940, were shown. Lighter entertainment was furnished by a professional comedian and a vaudeville singer. Both members and guests thoroughly enjoyed themselves.

The door prize, a pair of Kirkhill rubber shoes, donated by T. Kirk Hill, president of the company bearing his name, was won by J. H. Riddell (U. S. Rubber), and the special prize, a portable radio, donated by Ed Royal, of H. M. Royal, Inc., was won by Frank L. Shew (Darnell). Three copies of Mr. Ainsworth's book were also awarded by Mr. Hill as special prizes.

A communication from Bill Holmes, chairman of the group last year, who was recently made sales manager of the Dill Manufacturing Company and transferred to the company's headquarters at Cleveland, was read. Tentative plans for the next several programs were discussed. The next meeting of the group will be held at the Mayfair Hotel on Tuesday, March 4.

New Specifications Available

The Government Printing Office has released the new Federal Specification ZZ-R-601a, which contains revised Methods of Physical Tests and Chemical Analyses to be used in connection with Federal specifications for rubber products. The revision, the first to be made on these specifications, was approved by the Director of Procurement on June 25, 1940, and its use becomes effective not later than March 1, 1941, although it may be put into effect at an earlier date if preferred. Copies of the new specifications may be secured from the Superintendent of Documents, Washington, D. C., at 15 cents each.

The American Chemical Society has purchased buildings on the corner of Sixteenth and M Streets in Washington, D. C., for use as national headquarters. The site was selected by a special committee recently named by the Society. Continued expansion of the membership made the acquisition of larger quarters imperative.

FINANCIAL NEWS

U. S. RUBBER REPORTS PROFIT OF $11,425,241

Based on net sales of $228,988,780, the highest total in the past twenty years, the United States Rubber Company reports a consolidated net profit of $11,425,241 for the year of 1940, an increase of 12% over the net of $10,218,849 reported in the previous year. After full dividend requirements of $8.00 a share on the preferred, the 1940 net is equivalent to $3.58 a share on the common stock outstanding, as compared with $3.18 in 1939. Sales of the former Fisk Rubber Corporation, whose assets were acquired by U. S. Rubber in December, 1939, are consolidated in the report.

The consolidated balance sheet as of December 31, 1940, shows total current assets of $121,108,117, including $20,010,453 in cash, $34,896,903 in accounts and notes receivable, $28,840,248 in finished goods, and $26,270,828 in raw materials, against total current liabilities of $38,562,844, including $23,906,220 in accounts payable, $9,009,975 in accrued taxes, and $5,646,649 in other accrued liabilities. At the end of the previous year total current assets amounted to $105,219,989 and liabilities to $30,710,115.

A statement accompanying the report to stockholders revealed that an aggregate amount of $26,004,002 in direct taxes was charged against operations during 1940, these taxes including $12,423,681 of Federal excise taxes on tires and tubes, $2,425,096 of social security taxes, $3,889,083 of Federal income taxes, and $2,645,510 of foreign income, war defense and excess profits taxes. Total wages and salaries of $64,637,000 were paid during the year to an average of 41,889 employees, exclusive of 20,439 plantation employees. The number of employees, excluding plantation workers, increased 10% over the previous year.

A considerable portion of the report is devoted to an analysis of the company's foreign assets. The analysis shows a total of $21,476,197 invested in plantations in British Malaya and the Netherlands East Indies, $11,185,303 in Canada, $677,298 in England, and $124,419 in Continental Europe. Less than $802,000 is now accounted for in England and Continental Europe, as compared with $1,900,000 reported at the end of 1939, the decline being explained largely by the liquidation of stocks of goods on hand at the beginning of the year and by collection of accounts. Canadian assets, however, increased from $9,930,000 at the end of 1939 to $11,185,000.

The plantations, the report states, now comprise approximately 132,000 acres, of which 102,000 have been planted and 89,000 are mature. From the 88,000 acres which were tapped during 1940, the company produced 65,157,000 pounds of rubber, a new high average yield of 741 pounds an acre, which compares with 689 pounds last year. Of the tapped acres, 62,000 are in the Netherlands East Indies and 26,000 in British Malaya. The plantations contributed $2,054,595, or approximately 18%, of the income.

During the year, the report continues, a total of twelve subsidiary corporations were liquidated, including Gillette Rubber Co., several Canadian subsidiaries, and several which were acquired in the Fisk transaction in 1939. The full consolidation of the company and its subsidiaries as presented in the report consisted of the parent concern and 29 subsidiaries, three of which are incorporated in Canada, four in the Far East, and ten in other foreign countries. All of the subsidiaries are wholly owned by the U. S. Rubber Co., except four in which there are minority interests.

NET PROFIT OF $6,104,993 REPORTED BY B. F. GOODRICH

Consolidated net profit of the B. F. Goodrich Company for 1940 amounted to $6,104,993, after provision for depreciation, interest, income taxes and other charges, according to a preliminary unaudited report. The profit, equal to $3.10 a share on 1,303,255 shares of common stock after provision for dividend requirements on the $5 cumulative preferred, compares with one of $6,628,746, or $3.50 per share, reported for 1939.

Consolidated net sales for the period covered in the report amounted to $145,347,775, an increase of 7.1% over sales reported for 1939. Accounts of certain subsidiaries located in belligerent foreign countries were not included in either the 1939 or 1940 reports. Federal income taxes in 1940 totalled $2,215,000, an increase of $1,015,000 over those paid in the preceding year.

Dayton Rubber Manufacturing Co.

Year Ended October 31: Net profit of $518,897, equal after preferred dividends, to $2.41 a share on the outstanding common stock, which compares with $783,582, or $3.91 per share, in the preceding fiscal year. Net sales amounted to $8,334,053, a 7% decline from the $8,973,712 reported for the year ended October 31, 1939.

ADVERTISING PAGES REMOVED

GENERAL TIRE & RUBBER CO. REPORTS PROFIT OF $595,917

For the fiscal year ended November 30, 1940, the General Tire & Rubber Company reports a net profit of only $595,917, after depreciation, Federal income taxes, and other charges, which is equivalent to 86c each on 526,847 shares of common stock after allowing for dividends on the 6% preferred stock. This compares with $2,137,318, or $3.77 a share, in the preceding fiscal year. Net sales for the year reported amounted to $23,214,314, against $24,048,829 in the 1939 period.

Explaining the "disappointing results," William O'Neil, president, said the principal reasons were that prices of tires in the replacement market were too low to allow satisfactory profits and the company's strike which lasted from April 10 to June 26. He revealed that an expanded factory and sales program had been formulated for the current year to meet the demands of the defense program, and expressed optimism on the sales outlook.

Mr. O'Neil also announced that the company's plant in Venezuela is under construction and should be ready for production late in March. General Tire has a management contract to operate the plant. Negotiations have already been started for the formation of a company in Chile. The company, it was stated, has practically completed liquidation of its inventories and receivables in Holland and the Scandinavian countries.

Baldwin Rubber Company

Fourth Quarter: Net profit of $208,586, equal to 60c a share on 315,754 shares of $1-par common stock, which compares with $160,678, or 51c a share, in the corresponding quarter of 1939. For the six months ended December 31, 1940, net profit amounted to $290,061, or 92c a share. Since the company has changed its fiscal year to end June 30, no comparison with the previous six-month period is available.

New Jersey Zinc Co.

For 1940: Net income of $8,236,815, equal to $4.19 a share on 1,963,264 shares of capital stock, which compares with $5,299,055, or $2.70 a share, in the previous year. In the final quarter of the year the company earned $3,122,351, or $1.59 a share, which compared with $1,796,195, or 91c a share, for the preceding quarter and $1,791,116, or 91c a share, in the corresponding quarter of the preceding year.

Collyer Insulated Wire Co.

For 1940: Net income of $167,900, equal to $1.12 a share on 150,000 shares of no par capital stock, which compares with $33,579, or 22c a share, reported for the year ended December 31, 1939.

SYNTHETIC RUBBER PROPERTIES DISCUSSED AT S.A.E. MEETING

Included among the papers given at the annual meeting of the Society of Automotive Engineers, held at the Book-Cadillac Hotel in Detroit, Mich., the week of January 6, was one on the "Properties of Some Synthetic Rubbers," by L. B. Sebrell and R. P. Dinsmore of the Goodyear Tire & Rubber Co., Akron. The authors quoted Stoecklein's division of highly-polymerized rubber-like materials, dividing them into two general classes, as follows:

1. Synthetics capable of vulcanization:

a. Butadiene co-polymers.

b. Reaction products of dihalogenated aliphatic compounds with sodium polysulfide.

2. Synthetics incapable of vulcanization:

a. Polymerized isobutylenes (similar to Vistanex) or polymerized acrylic acid esters (similar to Plexigum and like materials).

b. Products having rubber-like properties in combination with certain plasticizing agents (as, for example, Koroseal).

The authors confined themselves to a discussion of types falling in the first class. These rubbers have been compounded into two main types of formulae: (1) a formula containing approximately 40 parts of hard carbon black and giving a rubber stock of the type usually used in tire treads; and (2) a formula containing 50 parts of soft carbon black and being, in general, representative of the formula which would be used in mechanical goods.

While all synthetic rubbers possess elasticity and resilience, they differ very considerably in their molecular make-up, and it should therefore not be expected that they can be processed in the same way as natural rubber has been processed for many years.

Each synthetic rubber constitutes a different chemical compound. They are similar only in certain superficial properties. In regard to some of their properties, as, for example, resistance to solvents such as gasoline, benzene, and lubricating oil, some of the synthetic rubbers are very much better than natural rubber. Some, when properly fabricated into a tire, have been found to show superior abrasion resistance to that of natural rubber. In other properties, such as resistance to very low temperatures and tackiness, they are sometimes quite deficient.

We should look upon synthetic rubber, not as a material which can be universally substituted for the natural product, but as a material having special properties which, when properly handled, will give improved results as compared with natural rubber. On the other hand, we should look upon it as a material whose development and perfection will liberate us from the threat of embargo of natural rubber during the time of national emergency and as a guarantee that the price of the natural product will never again reach the peaks which have characterized it in the past.

The artificial rubbers for which test data were given in the paper included the Neoprene types, the Buna types, Thiokol, Chemigum and the Hycar synthetic rubber manufactured by Goodrich. The compounding properties of Neoprene and Thiokol are generally well understood. Chemigum and Hycar are new types of synthetic rubber which in general have the same properties as Buna rubber.

Quantitative values were given in the paper for the extrusion plasticity, the tensile strength, elongation, modulus at 300 per cent elongation, durometer hardness, rebound resilience, flexing, volume increase in X-70 gasoline in 12 days, and Grasselli abrasion loss for the tread compound and the tensile strength, elongation, Shore hardness, volume increase in X-70 gasoline in 12 days and in benzol in 12 days, and of the dynamic resilience and pendulum rebound for the mechanical goods compound.

Reports from the San Juan River region in Nicaragua indicate that agents for German firms are purchasing rubber in that area. The small exports of rubber from that territory have been in the hands of Nicaraguan firms, some of which are controlled by persons of German origin.

Toyad Mainliner Dolls

Two "Mainliner" dolls, called Captain Bill and Stewardess Sue, respectively, have been added to the line of foam latex toys and novelties fea-

tured by The Toyad Corporation, Latrobe, Penna. The dolls are seven inches high, with authentic uniforms and insignia of the original United Air Lines characters. Flesh-like, cute and washable, the dolls are also harmless, indestructible and appealing. Both dolls are packed in an attractive gift box which retails at $1.00. Toyad operates under the Firestone patents.

DEFENSE IS PUT FIRST BY FIRESTONE PRESIDENT

A call for an intensified production effort and more toil and sacrifice on the part of all elements in our national life was sounded by John W. Thomas, president of the Firestone Tire & Rubber Co., in an address to the annual stockholders' meeting of the company, held in Akron on January 15.

"We prefer butter to bombs, but if we must have both it will take much more toil and sacrifice on our part," he said. "Reports from abroad indicate that the only real secret weapon of the aggressor nations is hard work and lots of it, and that weapon is no secret to the American people.

"No set of circumstances nor any situation must be allowed to arise that will interfere with our goal of adequate preparedness. All elements in our productive economy must realize that we cannot allow our usual comforts and conveniences to interfere with our pressing defense needs."

He announced that Firestone was expanding its facilities as rapidly as possible and that every plant was working at capacity to meet the needs of the Government's rearmament program and the requirements of the company's customers.

He also announced that Firestone had recently completed and placed in production on a commercial basis a new synthetic rubber manufacturing plant in Akron and had plans for doubling its capacity during the coming year. He reported steadily increasing production of rubber on Firestone's Liberian plantations which now have 72,500 acres of rubber trees.

Goodyear Aircraft Corp., Chrysler Corp., and the Glenn L. Martin Company have inaugurated a plan designed to speed up the production of bomber planes. According to the plan, still in the tentative stage, Martin will erect an assembly plant, probably in Indiana, and Goodyear and Chrysler will manufacture the parts needed to assemble at least 100 big bombers each month.

Ratification of a new contract between the Detroit plant of U. S. Rubber and Local 101 of the United Rubber Workers of America, which provided for wage increases and vacations with pay, averted a threatened strike at that plant last month. The wage increases were announced as 3 cents per hour generally for the plant's 6,000 employees.

Firestone has begun regular production on tires intended for earthmoving equipment, described as the largest tires in the world. The maximum overall diameter of the mold used for these tires is 10 feet 7 inches. The mold cures a tire that is 9 feet 6 inches in diameter in 15 hours.

NAMES IN THE NEWS

DR. WALDO L. SEMON, vice-president, Hydrocarbon Chemical & Rubber Co., stressed the importance of synthetic rubber to the National Defense Program in a talk given before the annual convention of the Compressed Gas Manufacturers' Association in New York City on January 21.

DON E. SCHLEMMER, who joined the B. F. Goodrich Company, Akron, four years ago after spending 12 years in the retail drug field, has been named assistant sales manager of the company's sundries division.

THOMAS W. BACCHUS resigned as vice-president and a member of the directorate of the Hercules Powder Co., Wilmington, Delaware, last month. He has been vice-president since the company's formation in 1913.

WALTER C. JACOBS has been named direct factory representative in the Washington district for the Western Insulated Wire, Inc., of Los Angeles. His headquarters are at 722 Albee Building, Washington, D. C.

JOHN M. BALL, who will complete twenty years of service with the R. T. Vanderbilt Company next May, has been named editor of the *Vanderbilt News*, technical house organ issued by the company every other month. He succeeds DR. WILLIAM F. RUSSELL, who will continue to act in an advisory capacity.

W. H. PITNER, vice-president of the Central Service Engineering Company of Chicago, was appointed vice-president and sales manager of the Pharis Tire & Rubber Co., Newark, Ohio, last month. He succeeds W. A. PATTERSON, resigned.

JOHN J. BUCKLEY, formerly an executive of the Taft Pierce Company of Woonsocket, R. I., has been appointed works manager of the Philadelphia plant of the Sharples Corporation, manufacturers of high speed centrifugals and centrifugal processes.

PHILIP HANDERSON, who recently resigned from the B. F. Goodrich Company, after nine years of service as director of advertising and publicity, has been named sales promotion and advertising manager of the Ferguson-Sherman Manufacturing Corp., Dearborn, Mich., makers and distributors of farm implements.

FRANK C. WITWER, associated with the treasurer's office of the University of Akron for the past five years, has been named auditor and office manager for the Alliance Rubber Co., Alliance, Ohio.

PARKE MASTERS, formerly associated with the R. & H. Division of E. I. du-Pont de Nemours & Co., Inc., has joined the sales force of the Warwick Chemical Co., West Warwick, R. I., manufacturers of metallic stearates. He will maintain headquarters in Boston.

GEORGE J. BURGER has resigned as secretary and general manager of the National Association of Independent Tire Dealers, Inc., and has established himself as a tire consultant with offices at 250 West 57th Street, New York City, the same building in which the Association has its headquarters. No successor has been named at this writing.

ROLAND H. GRAY, plant manager of the Goodyear fabric plant in Decatur, Alabama, has been appointed to head operations at the Charleston, Indiana, plant of the Goodyear Engineering Corp., the organization recently formed by Goodyear to manufacture bagging for explosives. The plant is government-owned.

JOSEPH ROCKOFF, chief chemist, Dayton Rubber Manufacturing Co., Dayton, Ohio, delivered a paper on "Recent Trends in Rubber Technology" as part of a symposium on "Industrial Colloids" sponsored by the Department of Chemical Engineering of the University of Cincinnati at Cincinnati last month.

DR. R. H. ULRICH, chief, interplant division, General Tire & Rubber Co., returned last month from an extended visit to Portugal where he investigated the possibility of locating a tire factory.

J. S. OVERSTREET, associated with the General Electric Company since 1929, largely in the cable engineering field, has been placed in charge of that company's wire and cable sales, with headquarters at Schenectady, N. Y.

DR. H. I. CRAMER, secretary, Division of Rubber Chemistry, A.C.S., and affiliated with the University of Akron, delivered an address on synthetic rubber before the Milwaukee (Wis.) Chapter of the American Chemical Society last month.

JAMES W. SCHADE, research director, B. F. Goodrich Co., Akron, discussed "Rubbers, Natural and Synthetic" before the annual meeting of the Institute of Aeronautical Sciences, held at the Biltmore Hotel in New York City on January 30. The address was part of a symposium devoted to organic and synthetic materials of which DR. WILLIAM C. GEER was chairman.

Heads Sales for Drill Mfg. Co.

William C. Holmes

William C. Holmes, who has served as Pacific Coast representative of the Dill Manufacturing Co., Cleveland, Ohio, since joining that company in 1929, has been appointed to the office of manager of sales, succeeding the late Louis F. Body. A graduate of William Jewel College, Mr. Holmes was associated with the Goodyear Tire & Rubber Company at one time, and for five years was in charge of that company's operations in Brazil. He assumes his new post with a broad experience in the sale of Dill tire valves and other products.

J. T. CROGHAN of the Boston Woven Hose & Rubber Co., and E. L. Nute of the Converse Rubber Co., participated in the Plant Engineer's Quiz Session sponsored by the Technical Advertising Association at a meeting of the Association held at the Engineers Club in Boston, Mass., on January 17.

LEONARD K. FIRESTONE, trade sales manager, Firestone Tire & Rubber Co., was the choice of the Akron Junior Chamber of Commerce last month for the "outstanding young man of Akron for 1940." He was presented with a distinguished service key at a banquet held in the Mayflower Hotel on January 23.

DR. RICHARD M. HITCHENS, group leader in the organic chemicals division's research department of the Monsanto Chemical Co., has been promoted to the post of assistant research director of the division.

SEIBERLING FAMILY LOSES IN LOAN RECOVERY ATTEMPT

The attempt of the Seiberling family of Akron to recover $634,000 from Edgar B. Davis, Texas oil man, and formerly an executive of the U. S. Rubber Co., in a dispute over a $500,000 loan, was lost on January 14 when Judge Frank J. Lausche ruled in favor of the Ohio Goodyear Securities Corporation, holding that "no trust was established" in connection with the transfer of $500,000 to that organization several years ago.

According to the testimony of Frank A. Seiberling, founder of the Goodyear Tire & Rubber Co., and now chairman of the board of the Seiberling Rubber Co., he borrowed $500,000 from Mr. Davis, which was later repaid, and the suit was brought to reclaim assets which he claimed he had deposited in trust with the Ohio Goodyear Securities concern, controlled by Mr. Davis. He specifically requested that 10,500 shares of U. S. Rubber common stock and $342,973 in cash, held by Ohio Goodyear, be declared his property and be turned over to the plaintiffs, to whom he had assigned his interests.

The point of the contention was that Mr. Seiberling had organized the Prudential Securities & Realty Company in 1921 which took absolute title to his property and assets and held them for the purpose of discharging his obligations to certain specified creditors. In 1926, Mr. Seiberling asked Mr. Davis to guarantee the payment of notes and other evidences of indebtedness which had been issued by Prudential and to meet that guarantee Mr. Davis purchased the Prudential concern.

New Company Acquired Assets

Later, Mr. Davis organized the Ohio Goodyear Securities Company and assigned all of the rights, benefits and obligations vested in and imposed upon him by his contract with Prudential to the new company for certain considerations. It was the claim of the Seiberlings, as plaintiffs, that the purchase of Prudential by Mr. Davis created a trust under which the rights obtained under the contract were to be held legally by Mr. Davis while the equitable right and interest thereto was to remain with Mr. Seiberling. The latter contended during the trial that Mr. Davis took title to the assets of Prudential only to protect himself against loss by reason of his guarantee and it was understood that the overage after the obligations were met would be returned to him as his property.

The court held, however, that the trust was not continued when the assets of Prudential were turned over to the Ohio Goodyear Securities Corporation, which "operated as a separate entity and with the consent of Mr. Davis and Mr. Seiberling dealt with its assets absolutely and without a single token that they were held in trust." A motion for a new trial has been made by the Seiberling attorneys and it is understood that an appeal will be made if the motion should be denied.

Cotton in Tires

According to the Cotton-Textile Institute, tire manufacturers in the United States used a total of 316,870,000 pounds of cotton in 1939. An average of 5½ pounds of cotton was used per tire, it is estimated, which means that the average tire produced in 1939 was composed from one-third to one-half of cotton.

POSITION OF FOREIGN PLANTS IS OUTLINED BY LITCHFIELD

The position of the company's foreign factories was outlined by P. W. Litchfield, chairman of the board of the Goodyear Tire & Rubber Co., in an address made before a meeting of Goodyear dealers held at the Waldorf-Astoria in New York City on January 23. Before reaching this point in his address, however, Mr. Litchfield told his audience of steps being taken in the United States to protect its supplies of rubber.

Mr. Litchfield sketched briefly conditions in the foreign plants of his company. In the British plant in Wolverhampton, thirty miles from Coventry and fourteen miles from Birmingham, the personnel has been increased from 1,750 to 2,150 in the manufacture of tires for war purposes. Factory workers put in eight hours every day and get one day off in twenty-one, so great is the demand.

Output at the Norkopping plant in Sweden has been sharply curtailed. At Buitenzorg, Java, the entire output of the tire factory is being taken up by the defense needs of Netherlands East Indies. The Canadian factory is working to full capacity, while plants in Brazil and Argentina suffer from the reduced business activity in those countries resulting from the loss of export trade.

In Australia, loss of the passenger-car market has been partly offset by enlarged demand for truck and other war equipment tires, Mr. Litchfield reported.

Mr. Litchfield declared that "we must give all aid to heroic Britain" and "prepare in every way for our own defense." Discussing synthetic rubbers, he said that the American product was superior to the German synthetics "in every way." An elaborate traveling display of products now being manufactured by Goodyear for both defense and commercial needs was shown at the meeting as was a motion picture called "Goodyear Shoulders Arms."

PRODUCTION OF ZINC PIGMENTS LIMITED BY DEFENSE DEMANDS

For some time there have been rumors to the effect there may soon be a shortage of zinc pigments for the rubber and other industries. The true status of this state of affairs has been brought out into the open by the New Jersey Zinc Company, one of the leaders in the field, which, in the February, 1941, issue of *The Activator,* its house organ, makes the following statements:

An unprecedented demand for zinc metal, caused chiefly by the national defense program, has necessitated our limiting the production of all of our zinc pigments produced from the metal in order that the greatest proportion of our metal output may be made available for use in the various products vital to defense. To be more specific, this limitation applies to all of our French Process and Palmerton Process (Kadox) Zinc Oxides, several grades of which have been used in increasing quantities in the rubber industry for a variety of products.

Fortunately, these special brands of metal zinc oxides to a large extent can be replaced in your present compounds by American Process Zinc Oxides which at present and for the future will be more readily available. The data presented in the charts (see below) should be of material assistance in reviewing your compounds to determine the suitability of American Process Zinc Oxides for your particular requirements.

Up to the present time we are happy to report that we have been able substantially to supply the pigment requirements of our regular customers in the many industries we serve. In view of existing conditions, however, which are beyond our control, we naturally cannot make accurate predictions for the future. Therefore, as our position in relation to zinc oxides made from metal is as vital to us as it is to our many good customers in the rubber industry, we feel that this statement of our position will be of mutual benefit.

The issue of *The Activator* in which these statements appear also reproduces the series of rate of cure charts publicized by New Jersey Zinc several years ago with the intention of familiarizing the rubber chemist with the results to be expected with various types of zinc oxides when used with various accelerators in rubber compounds. In the light of the present situation on zinc pigments, it is believed these charts hold special interest to rubber compounders at this time.

The December, 1940, issue of the *Carbon Black Bulletin,* issued intermittently by Godfrey L. Cabot, Inc., Boston, Mass., is devoted to a discussion of "The Effect of Carbon Black on the Electrical Conductivity of Rubber." The deviation from Ohm's law and the effect of electrode material are explained.

CANADIAN NEWS

Sidney R. Skelton has been appointed advertising manager of the Goodyear Tire and Rubber Company of Canada, Ltd., New Toronto, Ontario.

Mr. Skelton left the J. J. Gibbons advertising agency in Toronto five years ago to join Goodyear. At first in charge of the company's house magazine he traveled across the Dominion visiting all of the company agencies and offices and gained a thorough insight into the merchandising, sales and advertising problems of the rubber industry. He has been acting in the capacity of advertising manager for the past year and the appointment is now made permanent.

Mr. Skelton was born in Toronto and educated at Long Branch, Ontario. He is a member of the Association of Canadian Advertisers and has been active in the Advertising and Sales Club of Toronto.

Lieutenant Paul M. Irwin, formerly tire sales manager of the Dominion Rubber Company, Ltd., is now serving somewhere in Great Britain with the Canadian Active Service Force.

Dan G. Seebach, who has been chief accountant of the B. F. Goodrich Co. of Canada, Ltd., for the past twelve years, was recently appointed controller of the company.

E. F. Sweeney, formerly of New Bedford, Massachusetts, has been appointed manager of the Firestone Cotton Mills of Canada, Ltd., Woodstock, Ontario, to succeed J. J. Harney who has been transferred to the New Bedford plant.

R. C. Berkinshaw, treasurer and general manager of Canadian Goodyear, was renamed a director of the Toronto Industrial Commission at the annual meeting held in January. Sixteen new companies commenced operation in Toronto during 1940, it was announced at the meeting.

The Seiberling Rubber Co. of Canada, Ltd., Toronto, has reported earnings of approximately $1 a common share for the fiscal year ended October 31, 1940. Majority of the common stock is held by the parent Akron company.

The balance sheet shows current assets of $947,600, including $1,800 in cash, $341,121 in accounts receivable, $94,678 due from the Dominion government for expenditure on new equipment, and $510,001 in inventories. Current liabilities are $1,176,626, an excess of $229,026 over current assets, and include bank loans of $202,235, bills under discount of $96,672, other accounts of $370,459, and $507,260 owed to the parent company.

Gross profits amounted to $345,357 in 1940 compared with $364,052 for the previous year. Net earnings were $95,717 compared with $108,225. Net profit for the year amounted to $31,716 compared with $31,397 in 1939.

President R. J. Thomas states that the company's plant is operating seven days a week, largely on government orders, and will probably continue at this pace for some time to come. Steps are being taken to prevent any possible interruption in raw material supplies. Inventories totalled $510,001, considerably higher than the $353,384 reported a year earlier.

Hearings have been started under the Industrial Disputes Investigation Act into purported grievances of the employees at Canadian Goodyear's mechanical rubber goods plant at Bowmanville, Ontario. Mr. Justice Gillanders is chairman of the board of enquiry, F. A. Brewin represents the employees and V. A. Sinclair, K.C., is representing the company.

The right of the United Rubber Workers to sole bargaining rights for the employees, and the question of higher wages are the matters under dispute.

Crude rubber imports into Canada showed a tremendous increase during the month of November, 1940. This is believed to be due to the fact that the Dominion government is attempting to set up an adequate stock of raw materials and is operating through the Fairmont Company, Ltd., government established commodity company, to build up a rubber reserve. Imports for November amounted to 11,311,687 pounds compared with 3,363,319 for the same month in 1939. The total for the first eleven months of 1940 was 97,452,005 pounds compared with 63,994,328 for the same period in 1939, an increase of 52.3 per cent.

Underwriters' Laboratories, New York and Chicago, has issued a fourth edition of its Standard for Rubber-Covered Wires and Cables. The outstanding feature of the new edition is the inclusion of requirements for four new types of rubber-insulated conductors —Types RW, RHT, RPT and RU. Applications are being accepted for the investigation of wires and cables of all these new types.

FEDERAL LOAN ADMINISTRATOR REPORTS ON RUBBER ACTIVITY

In a letter to the President and the Congress of the United States, under date of January 18, Jesse Jones, Federal Loan Administrator, reviewed the authorization of the Reconstruction Finance Corporation, formed primarily to aid the government in its national defense program, and included the following report on commitments made by that corporation:

In aid of the defense program, under this and other authority, the R.F.C. has made commitments aggregating approximately $1,100,000,000. These include the creation on June 28, 1940, of the Rubber Reserve Company to acquire a reserve supply of raw rubber. $5,000,000 was subscribed to the capital stock of this company, and with the approval of the R.F.C. it has agreed with the International Rubber Regulation Committee, which controls the world output of raw rubber, to purchase up to 430,000 tons of crude rubber, costing approximately $190,000,000. 52,516 tons have been delivered, 20,139 tons are in transit, and 16,343 tons await shipment. We should accumulate the balance during 1941.

In order not to interfere with the requirements of the rubber industry, we are buying in cooperation with the industry at approximately 20c a pound. The industry agreed with us to carry not less than 150,000 tons to meet its current needs. It is doing this, and, in addition, as of December 31st, had accumulated an excess of 56,000 tons. In order for us to accumulate this reserve supply, the International Rubber Regulation Committee by agreement with us has authorized increases in the normal world output of approximately 50%.

In addition to our reserve, the Commodity Credit Corporation has 80,000 tons on hand, 10,000 tons afloat and 5,000 additional tons awaiting shipment. This rubber was acquired in exchange for cotton under the 1939 barter agreement with Great Britain.

Buffalo Meets February 28

The next meeting of the Buffalo Group, Rubber Division, A.C.S., will be held on February 28 at the Hotel Lenox in Buffalo, N. Y. The speaker will be Mr. Roy Clay, engineer of the Curtiss Airplane Division of the Curtiss-Wright Corporation who will talk on the use of rubber in the construction of modern aircraft.

Announcement has been made that a memorial will be erected to the late Colonel Arthur F. Townsend, chairman of the board of Raybestos-Manhattan, Inc., and general manager of the Manhattan Rubber Division, by the employees of the Passaic plant and others. It will be in the form of a bronze flagstaff and will be erected on the company's grounds.

LOS ANGELES NEWS

R. B. Stringfield, active member of the Los Angeles Rubber Group, has been appointed co-ordinator of engineering defense training programs at the University of Southern California.

Herman J. Jordan, representative of the organic chemicals department of E. I. du Pont de Nemours and Company, San Francisco, regular visitor in Los Angeles, reports the death in Prague, Czechoslovakia, of his father-in-law, Jan Kubelik, world-famous violinist.

T. Kirk Hill and Edward W. Royal are scheduled to leave March 22 for a three weeks trip to Mexico City and environs. While sightseeing is the main motive, some fishing in a Mexican mountain lake is tentatively included in the schedule.

J. C. Herbert, general manager of the Los Angeles plant of the B. F. Goodrich Company, is back at work after a severe illness.

Harold Rehfeld, former chief compounder for the B. F. Goodrich Company here, is now in the Oaks, Pennsylvania, plant. When he left here three months ago he went to the Akron plant.

Carl Stentz, proprietor of the Latex Seamless Products Company, has added a heating unit to the equipment in his plant. This takes care of drying work throughout the entire plant replacing portable drying units formerly used.

Ed Royal is royally ensconced in modernized offices with space added for a new private office for himself. The entire interior has been rejuvenated with new desk arrangement, fluorescent lighting, non-glare glass in the windows, rubber tile on the floor, and a new walnut desk.

Wallace E. Cake, director of research on the rubber plantations of the U. S. Rubber Company in the Netherlands East Indies, who has been in America for some time, was in Los Angeles for a few days when on his way back to his headquarters in Boenoet, Sumatra. Mr. Cake is leaving his family in the United States.

Rapid strides are being made in repairing the building occupied by the Golden West Rubber Company at 8228 S. Central Avenue, the building having been badly gutted in a fire which destroyed much of the machinery and a supply of stock, temporarily putting the plant, which manufactures camel-back only, out of business. It is expected that production can be resumed in another month. The plant belongs to Hyman and Sol Goldberg who operate the Tire Clearing House at 1240 S. Broadway. Jim Stull, who has been sales manager for several months, has recently left the employ of the company.

Western Insulated Wire, Inc., 1001 East 62nd Street, has developed and is now producing a new type of aircraft cable which is smaller in diameter and lighter in weight than such cable formerly used, the product meeting U. S. Army Air Corps specifications, according to E. H. Lewis, vice-president and general manager. Mr. Lewis has but recently returned from a trip to the east coast. The company, he states, is contemplating expanding its plant with installation of complete copper drawing and annealing equipment. This will permit manufacture of fine wire sizes.

The Golden State Rubber Mills is manufacturing a new type of change mat, the improvement over other change mats previously manufactured being the vulcanizing of the name of the firm distributing it in white and at the edge of the mat next to the customer when change is being made. The mat is primarily an advertising medium intended for distribution by manufacturers or jobbers to outlet customers, etc.

The Arrowhead Rubber Company, 1976 Laura Street, Huntington Park, will soon move into a fine new building erected for the purpose at 2448 East 37th Street, Vernon. The new plant will have 12,000 square feet of floor space with 5,000 square feet adjoining available for later expansion if needed. The new building is one story with loft and with brick front. Further expansion is contemplated in the new location later in the year.

The Atlas Sponge Rubber Shop, 1480 East 56th Street, will move about April 1 into much larger quarters at 806 East 61st Street, according to Howard Lien, proprietor. Increased business has made the move necessary. The word "Shop" will be changed to "Company" following the move. Floor space will be doubled.

The Kirkhill Rubber Company went through the entire 52 weeks of 1940 operating 24 hours per day and seven days each week, according to T. Kirk Hill, proprietor. At the present time the company has a backlog 15 per cent greater than it had one year ago on the same date. Orders for full six months business in advance are now on hand, Mr. Hill states. The company is acquiring the property soon to be vacated by the Arrowhead Rubber Company at 1976 Laura Street, Huntington Park, and will in the future conduct all sponge rubber manufacturing operations there, operations now carried on in the main factory at Hoover Boulevard and Slauson Avenue. Operations in the new location are expected to begin in April, Mr. Hill states.

RUBBER PRODUCTS PROMINENT AT ANNUAL MOTOR BOAT SHOW

Rubber products—old and new—were very much in evidence at the 36th Annual Motor Boat Show, held at Grand Central Palace in New York City from January 10 to 18. One of the newer products was the Graph-Air Gun, which makes use of a rubber barrel for controlling air pressure in lubricating exposed and difficult-to-reach parts, shown by the Joseph Dixon Crucible Co. Another was the Rajah Safety Nipple, made of flexible rubber, which stretches over the terminal and insulator of any spark plug, thus assuring a water-tight job, shown by the Rajah Co., Bloomfield, N. J.

Goodrich cutless bearings, in a wide range of sizes and styles, were again exhibited by Lucian Q. Moffit, Inc., exclusive distributors, while the Akerite type of marine bearings were displayed by the E. J. Willis Co., of New York. The latter organization also displayed Goodyear Airfoam mattresses and cushions for marine use. U. S. Rubber's Royal Foam mattresses and cushions were on view in the booth of Cluff Fabric Products, Inc.

Armstrong & Galbraith, Inc., distributors of marine equipment, with headquarters in New York, exhibited the Coolerette Refrigerator Bag, a product of the Hodgman Rubber Co., which is essentially three complete bags in one, plus accessory bags for holding ice cubes or dry ice. The various compartments are heavily rubberized. The same concern displayed the Deckmaster, a suction cleaner which scrubs, mops, dusts, waxes and cleans, utilizing a special sponge rubber squeegee.

Other rubber products included a new type of rubber fender and gunwale protector, comprising heavy duck casings stuffed with ground latex sponge rubber, shown by Cluff Fabric Products, Inc.; Wearpruf rubber fenders, with various types of filling, displayed by the Socony-Vacuum Oil Company; Topsider footwear with non-slip rubber soles, exhibited by the Sperry Shoe Company; and all-rubber oar stops, shown by Wilcox, Crittenden & Co., Inc.

OBITUARIES

Carleton Ellis

Carleton Ellis, chemist and inventor credited with holding approximately 800 patents, and head of the Ellis-Foster Co., Montclair, N. J., consultants, died of influenza in St. Francis Hospital, Miami Beach, Florida, at the age of 64, on January 13. Mr. Ellis also maintained a laboratory in Key West, and was on his way to his winter home in Nassau when he was stricken ill.

Born in Keene, N. H., in September, 1876, Mr. Ellis conceived his first invention while still a student at the Massachusetts Institute of Technology. After being graduated, he started manufacturing a paint and varnish remover, then worked as a chemist for various organizations, and in 1908 opened his own laboratories in Montclair. His inventions ranged from an oil-cracking process used by Standard Oil to a soap which left no rings around the bathtub. Only the late Thomas Edison and John O'Connor, a scientist, were credited with receiving more patents than Mr. Ellis.

A prolific writer, Mr. Ellis contributed several important books to the technical literature. Among these were *The Chemistry of Petroleum Derivatives*, *The Chemistry of Synthetic Resins*, *Soilless Growth* and *Printing Inks*. He also contributed several articles to the official journals of the American Chemical Society, the American Physical Society, and others. Some of his works are accepted today as basic studies in colleges and universities.

Mr. Ellis was a charter member of the Inventors Guild and a member of the American Chemical Society, American Institute of Chemical Engineers, the Society of the Chemical Industry, the Chemical Society (of Great Britain), and from 1918 to 1921 served as president of the New Jersey Chemical Society. He leaves a widow, two sons and two daughters.

Richard H. Gillespie

Richard Henry Gillespie, editor of the *Stamford Advocate* and president of the Stamford Rubber Supply Co., manufacturers of the Factice brand of vulcanized oils, died in Stamford Hospital, Stamford, Conn., at the age of 63 on January 15 as the result of a heart attack suffered a week earlier.

Born in Stamford in August, 1877, Mr. Gillespie attended public and high school in that town, and went to work for the *Advocate*, an afternoon newspaper founded in 1829, when he was 18. His father, Richard Henry Gillespie, was directing the newspaper at that time and in 1923 Mr. Gillespie was named editor-in-chief. He was also treasurer and a director of Gillespie Brothers, Inc., publishers of the paper.

In addition to his newspaper work and his activities as president of the Stamford Rubber Supply Co., also controlled by the Gillespie family, Mr. Gillespie was active in other businesses. He was vice-president of the Viscol Company and of the Fidelity Title and Trust Co. of Stamford. He was also a director of the Stamford Savings Bank, Y.M.C.A., Beaver College and the Ferguson Library.

He was a Mason and a member of the New England Daily Newspaper Association. He served two terms as commodore of the Stamford Yacht Club and was a member of the Lido Club of Long Beach, N. Y. He leaves a widow, a son and two daughters.

Meredith H. MacKusick

Meredith Hall MacKusick, managing director of the Northwestern Rubber Co., Litherland, Liverpool, England, died on December 5 at Southport, England, after a short illness. Widely known in both British and American rubber manufacturing circles, he was 62 years old at the time of his passing.

Mr. MacKusick was born in Cambridge, Mass., in 1879. His early career was with the United States Rubber Company, and in 1909 he went to England to organize the Rubber Regenerating Company, now affiliated with U. S. Rubber. After spending several years in England he returned to the United States, but went back to England in 1924 at the request of the directors of the Northwestern Rubber Co. to reorganize and manage the affairs of that company.

An active sport enthusiast, Mr. MacKusick's favorite games included golf, tennis and badminton. His social activities included membership in the Free Masons.

Herbert M. Waldron

Herbert M. Waldron, retired secretary of the John Waldron Machinery Co., New Brunswick, N. J., died at his home, 33 Livingstone Ave., New Brunswick, at the age of 67 on January 21 after an illness of three weeks. Mr. Waldron was graduated from Rutgers in 1893. He was a member of the Holland Society of New York and Delta Chapter of Zeta Psi. A bachelor, he left three brothers and a sister.

Clifford S. Johnson

Clifford S. Johnson, associated with the Development Department, Naugatuck Chemical, Division United States Rubber Co., at Naugatuck, Conn., for the past eight years, died at his home in Naugatuck, on February 5, after a short illness. Due to his development work, he was widely known in the manufacturing field.

Born in Chicago on August 3, 1897, Mr. Johnson attended high school in that city and then attended the University of Chicago, being graduated in 1923. Shortly after being graduated he joined the Miller Rubber Company and remained with that company until 1929 when he became associated with the General Laboratories of U. S. Rubber in Passaic, N. J. He was transferred to the Naugatuck Chemical Division in 1930, first doing some work with reclaim and then later development work on latex compounding and application.

Mr. Johnson was a member of Lodge No. 517, F. & A. M., Akron, Ohio. Funeral services were held on February 8 with interment at Naugatuck, Conn. A widow survives.

William P. Pickhardt

William Paul Pickhardt, for many years a leader in the field of industrial and engineering chemistry and an officer and director of several prominent chemical firms, died at Lenox Hill Hospital in New York City at the age of 60 on January 22. Included among the firms with which he had been associated was the General Dyestuffs Corporation. He was regarded not only as an expert in the dyestuff field, but also in the synthetic rubber, plastics, petroleum and pharmaceutical industries.

Expanding Koroseal Plant

The plant for the production of Koroseal now under construction at Niagara Falls, N. Y., will be expanded far beyond the original plans, it was revealed by John L. Collyer, president of the B. F. Goodrich Co., during a visit to the site of the plant on January 31. Increasing demands for Koroseal, stimulated by the National Defense Program, have made the expansion necessary even before the original production unit has been completed, Mr. Collyer stated. No Ameripol will be produced at Niagara Falls, according to Goodrich officials.

A birthday party, attended by hundreds of friends and associates, was tendered to C. W. Seiberling, vice-president and treasurer of the Seiberling Rubber Co. and president of the Seiberling Latex Products Co., at the East Market Gardens, in Akron, on January 24. Mr. Seiberling was 80 years old on January 26.

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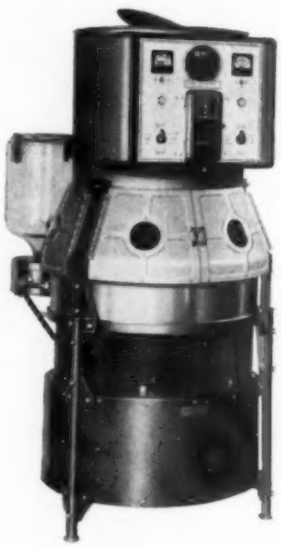
NEW EQUIPMENT

Improved Atlas Color Fade-Ometer

An improved Fade-Ometer, to be known as Model FDA-R, which supersedes all models previously merchandised by the company, has been introduced by the Atlas Electric Devices Co., 361 W. Superior St., Chicago, Ill. This instrument is used for the accelerated testing of fastness to light and for deterioration tests



where aging is caused by ultraviolet comparable to that found in the solar system.

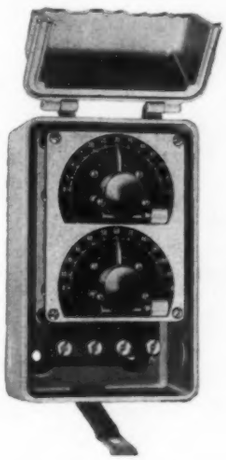
The new Fade-Ometer has a rotating sample holding drum, giving positive assurance that all specimens will receive exactly the same amount of light. It maintains temperature control within plus or minus 3° over a range of 95 to 150° F., using a visible-dial thermoregulator. Other features include higher relative humidity, ranging close to 60% on the average; constant water leveling device; improved glass-wool air filter; micrometer time clock adjustment; steady arc, assuring uniform ultraviolet output; all control instruments on one panel at eye level; and light for examining samples when arc is not burning.

Other features emphasized by the manufacturers include decals which call attention to places and time of cleaning, oiling, etc.; a guard to shield the eyes while loading or removing samples during operation of arc; the machine will pass through a standard size door; by-products of combustion such as found in open arc are largely eliminated; and pilot lights which indicate when main line current is on. The company advises that all Model FDA Fade-Ometers now in use may be converted into the new improved model.

Automatic Double Reset Timer

Especially adapted to industrial applications requiring an adjustable and rapidly repeating time cycle, a new automatic double reset timer has been introduced by the R. W. Cramer Co., Inc., Centerbrook, Conn. The new timer consists of two Cramer reset timer

mechanisms mounted upon a control panel and controlling common electrical circuits. Precision micrometer adjustments and "band-spread" time scales are provided to facilitate accurate settings. A die-cast housing provides both rugged and dust-proof protection and facilitates mounting and wiring. Either conduit or BX type wiring may be used. In addition, the housing may be locked as a protection against alteration of critical timing of industrial processes if desirable. In operation, once the unit has



been energized, the first timer closes the control circuit at the end of 90 seconds. The second timer then operates simultaneously with delivery of the desired impulse for a period of 10 seconds. The first timer has meanwhile reset and is again put into operation at the end of the 10 second interval when the second timer opens the control circuit and cuts off the impulse. The 90 second interval then recurs. Operation is thus continuous and according to the sequence determined by the settings of the timers until the external control switch is opened. The new double reset timers are furnished for 110 or 220 volt and 50 or 60 cycle operation. At present, time ranges available for each of the individual timers are 15, 30, 60 and 120 seconds, maximum.

BRIEFS . . . .

A new vertical mixing machine using the planetary principle and designed to accommodate 85 gallon bowls, as compared with the usual 20 to 25 gallon bowls, has been introduced by the American Machine & Foundry Co., 511 Fifth Ave., New York City. Termed the **AMF Glen "340" Mixer,** the new machine has wide adaptability for many mixing processes, including some in the rubber industry.

•

A new, longer-wearing alloy for valve stems and bonnets, called Hancodur, has been announced by the Hancock Valve Division of Manning, Maxwell & Moore, Inc., Bridgeport, Conn. The new alloy was developed expressly for use in the company's **Superfinished "500 Brinell" Bronze Valves.** Hancodur stems, the company reports, have a tensile strength of 90,000 pounds per inch.

Books . . . .

RUBBER RED BOOK—1939 Edition
Directory of the Rubber Industry
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ANNUAL BIBLIOGRAPHIES OF RUBBER LITERATURE
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LATEX IN INDUSTRY
By Royce J. Noble, Ph.D.
Text Book on Latex. Price: $7.00

LATEX AND ITS INDUSTRIAL APPLICATIONS (Vol. I)
By Frederick Marchionna
Bibliography of latex patents and literature to June, 1932. Price: $15.00

LATEX AND RUBBER DERIVATIVES AND THEIR INDUSTRIAL APPLICATIONS (Vols. II & III)
By Frederick Marchionna
Bibliography of latex patents and literature from June, 1932 to January, 1937; rubber derivatives to January, 1937. Price: $20.00
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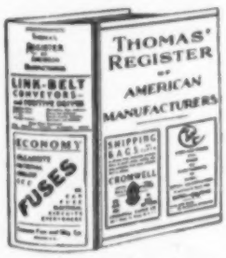

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REVIEWS

BOOKLETS, CATALOGS, Etc.

Elastic Recovery and Plastic Flow in Raw Rubber. By L. R. G. Treloar. British Rubber Producers' Research Association, 19 Fenchurch St., London, E.C. 3, England. 6 x 9½ in. 13 pp.

Reprinted from the April, 1940, issue of *Transactions of the Faraday Society*, this booklet presents the results of the first of a series of research progams sponsored by the British Rubber Producers' Research Association designed to determine a satisfactory theory of the structure of raw rubber which will account for all the physical phenomena displayed by this material. In the work covered, Whitby's methods were taken as a starting point, but greater care was exercised in securing the complete removal of elastic strain. The data given covers the elastic recovery of rubber at constant temperature, further recovery on raising the temperature, the non-recoverable extension or plastic flow, and the decay of tension at constant extension.

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Meehanite in Industry. Meehanite Research Institute of America, Inc., 311 Ross St., Pittsburgh, Penna. 8½ x 11 in. 52 pp.

This booklet contains a number of articles covering descriptions of applications of Meehanite castings in a number of different industries, including rubber, glass, mining and general processing. The original articles appeared in class and trade journals within the past few years. The article on the use of this relatively new metallurgically processed cast metal in the rubber industry is "Meehanite's Role in the Manufacture of Rubber Machinery," by F. L. Dawes of the Adamson Machine Co., which originally appeared in the July, 1940, issue of RUBBER AGE.

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Porter Double Cone Blender. Process Equipment Division, H. K. Porter Co., Inc., 5002 Harrison St., Pittsburgh, Penna. 8½x11 in. 4 pp.

The company's new double cone blender, designed to eliminate waste of time and materials in the blending of chemicals, plastics, rubber, and similar products, is described in this bulletin. A chart listing sizes, horsepower required, weight and other pertinent data, is included. Additional Porter products, including laboratory jar mills, are also illustrated and described.

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Koppers Chemicals from Coal. Tar & Chemical Division, Koppers Company, Koppers Building, Pittsburgh, Penna. 3¾x7½ in. 28 pp.

Data sheets in this booklet present the physical and chemical properties of a number of lesser known coal tar chemicals which are now being offered by the company on a commercial scale. Although some suggested uses are included in the data sheets, it is believed that many others will occur to potential users of these materials. Properties given in the booklet are those of pure compounds only.

•

Sealmaster Ball Bearing Units. Stephens-Adamson Mfg. Co., Aurora, Illinois. 8½x11 in. 32 pp.

The complete line of advanced design bearing units, which are pre-lubricated, self-aligning, and which feature the permanent centrifugal labyrinth seal which keeps out dirt and retains lubricant, made by the company, is described and illustrated in this attractive catalog. Load ratings for normal, standard and medium duty units are tabulated. Complete specifications are included.

Diffusion of Sulfur in Rubber. By A. R. Kemp, F. S. Malm, G. G. Winspear and B. Stiratelli. Bell Telephone Laboratories, Inc., 463 West St., New York City. 6 x 9 in. 26 pp.

This is a reprint of the paper delivered by the authors before the Cincinnati meeting of the Division of Rubber Chemistry, A.C.S., in April, 1940, which was originally published in *Industrial & Engineering Chemistry.* Various phases of the determination of the rate of diffusion of sulfur through rubber and the importance of its diffusion and solubility upon the control of the vulcanization reaction are discussed, and test methods outlined and explained. The need for further study in this field is emphasized by the authors.

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The Proteins of Hevea Brasiliensis. By G. R. Tristram. British Rubber Producers' Research Association, 19 Fenchurch St., London, E.C. 3, England. 7¼ x 10 in.

Comprising a reprint from an article in a recent issue of the *Biochemical Journal,* this booklet presents the results of an analysis made of a product isolated from dried latex. The product was a protein which was analyzed for amide-N, tyrosine, tryptophan, cystine, methionine, the basic amino-acids and the dicarboxylic acids. The protein, it was determined, is in many respects similar to those found in leaves of other plants, but further work is in progress to investigate the relationship of the isolated protein to the total protein of latex.

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RMA Manual of Tire Repairing. (Fourth Edition). Rubber Manufacturers Association, 444 Madison Ave., New York City. 6¾ x 9¾ in. 48 pp. 10c.

Completely revised, the latest edition of this manual deals with sectional repairing of tires and contains detailed information covering inspection, preparation, building and curing of repairs. The instructions and information contained in the manual have the backing of the leading tire repair experts of the country, and use of it should bring more successful repairs and greater tire economy to the car owner and more profitable business to the repairman.

•

Chemical Processing Equipment. (Bulletin No. 353). J. H. Day Co., Cincinnati, Ohio. 8x10½ in. 16 pp.

Mills, mixers, kettles, drums and other equipment made by the company for the chemical processing industry, including mixers for the rubber manufacturing industry, are illustrated and described in this new bulletin. Methods of securing different mixing actions by changing the position of agitators are discussed. The several types of agitators used by the company in its equipment are described.

•

Unitrol. Cutler-Hammer, Inc., Milwaukee, Wisconsin. 8½x11 in. 36 pp.

The development, operation and application of Unitrol, a new unit type of standardized motor control construction which permits all needed types of control devices to be easily organized into a complete, enclosed, sectionalized motor control center, are described in this attractive, two-color booklet. A sample specification for Unitrol sectionalized control center is given.

•

Apparatus for Checking Thermocouple Pyrometers. (Catalog E-33A-503). Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia, Penna. 7¾x10½ in. 28 pp.

Everything needed to check thermocouple pyrometers is listed in this catalog. The catalog not only illustrates and describes portable equipment for plant tests under actual operating conditions, but the laboratory apparatus to standardize it. Recommendations for the selection of proper checking apparatus are given.

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• *Are Bright in Shade*
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Reinforcing Fillers and Inerts
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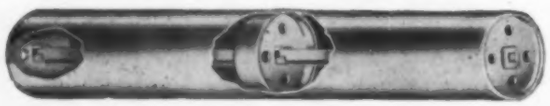
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THE W. F. GAMMETER COMPANY
CADIZ, OHIO

RMP ANTIMONY
• ATTRACTIVE
• NON-DETERIORATING
for RED RUBBER
RARE METAL PRODUCTS CO.
BELLEVILLE, N. J.

Buflovak Flakers for Cooling and Flaking Chemicals. (Bulletin 326). Buffalo Foundry & Machine Co., Buffalo, N. Y. 8½ x 11 in. 12 pp.

The various types and special features of the flaking machines made by the company for cooling and flaking such materials as calcium chloride, caustic soda, paraffin, pitch, stearic acid, wax, and similar products, are described and illustrated in this new bulletin. Latest developments and improvements are stressed. Specifications of the various sizes are given.

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Tag Celectray Pyrometers. (Catalog 1101F). C. J. Tagliabue Mfg. Co., Park and Nostrand Avenues, Brooklyn, N. Y. 8½x11 in. 32 pp.

Latest improvements made in the Celectray line of photocell, electric and light ray pyrometers, which incorporate high-speed photo-electric action, are listed and described in this latest pyrometer catalog issued by the company. Specifications for the different models of recording and controlling instruments are given. Emphasis is given to the special features incorporated in these devices.

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Hewitt Rubber Products for Industry. Hewitt Rubber Corp., Buffalo, N. Y. 8½ x 11 in. 36 pp.

The extensive lines of hose, belts, packings and other products made by the company for use by industry in general, are illustrated and described in this attractive two-color catalog. Sizes, ply, braid, working pressure and other data is given for the various types of hose, with specifications also given on other products. A table listing the materials which do not have a serious effect on rubber is included.

BOOKS

A.S.T.M. Standards on Rubber Products. Prepared by Committee D-11 on Rubber Products. American Society for Testing Materials, 260 S. Broad St., Philadelphia, Penna. 6 x 9 in. 264 pp. $1.75.

The latest compilation of these standards, giving 34 standardized specifications and test methods in their latest approved form, includes several new standards which were approved during 1940. Specifications and tests listed cover accelerated aging of vulcanized rubber, resistance to light checking, abrasion resistance, adhesion of rubber to metal, changes in properties in liquids, compression-deflection characteristics, and compression set. Requirements covering the T-50 test, ply separation, hardness and tear resistance are listed. Standards published include those for rubber hose and belting, gloves, matting, insulating blankets, friction and rubber insulating tape, insulating wire, cements, sponge rubber and hard rubber products. A 9-page bibliography, divided into various classifications, gives references to comprehensive and important recent publications on testing and test methods.

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Harmony in Verse. Selected Poems by Harmony Schupp. Published by A. S. Gilman, Inc., Cleveland, Ohio. Available from J. H. Winchester, Ohio Rubber Co., Willoughby, Ohio. 6 x 9 in. 64 pp. 75c (imitation leather binding); $1.25 (limp suede binding).

The sixty poems presented in this well-printed book have the rhyme and meter which mark the successful poet. But the surprising thing about these poems is that they were composed by a mother of four grown children who, in addition to putting in a full day's work in the trimming department of Ohio Rubber, takes care of her own household duties. Mrs. Schupp wrote poetry largely for her own amusement and pleasure. The poems, however, were deemed so good, that she was asked to select 60 of them for publication. These appear in the book reviewed.

MARKETS

Rubber – Crude, Reclaimed and Scrap – Cotton – Ducks – Tire Fabrics – Sheetings

NEW YORK, FEBRUARY 10, 1941

Crude Rubber

STARTING from a quotation of 20.00 on January 14, the price of spot rubber on the Commodity Exchange began dropping steadily a few points daily until it reached 19.20 on January 21, low for the period, and then began rising a few points daily until it returned to 20.00, the quotation made today (February 10). At no point was the rise or fall of the price spectacular, except on January 21 when it dropped 30 points, from 19.50 on the previous trading day to 19.20. Heavy accumulation of supplies and the absence of any active market support were the reasons given for the sharp drop. Prices have been moving into higher channels in the past several days principally because of renewed factory buying and recurring rumors from the Far East that shipping space is rapidly becoming more limited. Another reason given for the advancing prices is the higher freight rate from the Far East which goes into effect on March 1. Dealers anticipate higher prices shortly. Quotations in the outside market, Exchange, London and Singapore, follow:

As of February 10

Plantations—

Ribbed Smoked Sheets—

No. 1 Spot	—	@	.20
April	—	@	.20
July-September	—	@	.19¾
No. 2	—	@	.19⅝
No. 3	—	@	.19⅝
No. 4	—	@	.19¾
Thin Latex Crepe	—	@	.20⅛
Thick Latex Crepe	—	@	.20⅛
Brown Crepe, No. 1	—	@	.18¾
Brown Crepe, No. 2	—	@	.18⅝
Amber Crepe, No. 2	—	@	.18⅞
Amber Crepe, No. 3	—	@	.18¾
Brown Crepe, Rolled	—	@	.16

Latex—

Normal, per lb., carload lots	—	@	.24¼

Paras—

Up-River, fine	—	@	.17⅜
Acre Bolivian, fine	—	@	.17½

Balata—

Brazilian block	—	@	.14

LONDON MARKET

Standard Smoked Sheets—Buyers—February 10

April-June	—	@	12 7/32d
July-September	—	@	12¼d

SINGAPORE MARKET

Standard Smoked Sheets—Sellers—February 8

April-June	—	@	10 5/32d
July-September	—	@	9 1/32d

Scrap Rubber

Prices have changed on practically all grades of scrap since our last report. Auto tire peeling, mixed auto and beadless tire grades have dropped slightly, while clean solid truck tire stock has gone up a little. Dealers report sufficient stocks on hand to meet all current demands but anticipate a tightening up in the future. Current quotations follow:

(Prices to Consumers)

Auto tire peelings	ton 25.00	@	27.00
Mixed auto	ton 14.00	@	15.00
Beadless tires	ton 18.50	@	19.50
Clean solid truck tires	ton 32.00	@	34.00
Boots and shoes	ton 24.00	@	25.00
Arctics, untrimmed	ton 20.00	@	21.00
Inner tubes, No. 1	lb. .09	@	.10
Inner tubes, No. 2	lb. .04⅞	@	.05¼
Inner tubes, Red	lb. .04¾	@	.04⅞

Reclaimed Rubber

The increased demand for reclaim noted in January continued into February with practically all branches of the rubber manufacturing industry showing expanding interest. Based on the National Defense Program and improved business conditions in general, reclaimers anticipate increased demand in the early future. There has been no change in the price structure since our last report. Current quotations follow:

Shoe

Unwashed	lb. .06½	@	.06¾
Washed	lb. .10	@	.10¼

Tube

No. 2 (Compounded)	lb. .09	@	.10¼
Red Tube	lb. .09½	@	.09¾

Tires

Black (acid process)	lb. .07	@	.07¼
Black, selected tires	lb. .06	@	.06¼
Dark Gray	lb. .09¼	@	.10
White	lb. .12½	@	.14
Truck, Heavy Gravity	lb. .05½	@	.06
Truck, Light Gravity	lb. .07	@	.07½

Miscellaneous

Mechanical blends	lb. .04½	@	.05

Tire Fabrics

(Prices Net at the Mill)

Peeler, carded, 23/5/3	lb. .31¾	@	.32
Peeler, carded, 23/4/3	lb. .32¾	@	.33
Peeler, carded, 15/3/3	lb. .29¾	@	.30
Peeler, carded, 15/4/2	lb. .29¾	@	.30
Peeler, carded, 13/3/3	lb. .28¾	@	.29

CHAFERS

Carded, American, 1 1/16"	lb. .31¾	@	.32
Carded, American, 1"	lb. .24½	@	.32

Cotton

The price of middling uplands on the Exchange followed the trend of spot rubber in that it moved in a relatively narrow range—49 points—and climbed to a high, receded and then returned to the high level. Top quotation for the period was 10.94, reached on January 24 and again on February 10. Low was 10.45 on the first day of the period, January 14. The frequent drop in price was largely attributed to liquidation efforts while trade buying brought the price up again from time to time. Revelation that cotton consumption in December reached 775,000 bales, as compared with 744,000 bales in November, acted as a spur to the market. December consumption was exceeded only by the all-time high of 777,000 bales recorded in March, 1937. Trading in the past few days has been almost routine in character, there being some trade fixing and covering of hedges by spot interests which only infrequently amounted to quantities of more than a few hundred bales at a time. The trade agrees that the future of the cotton market is irrevocably linked with developments in the European conflict. Quotations for middling uplands on the Exchange follow:

	Jan. 13	February 10		
	Close	High	Low	Close
March	10.48	10.39	10.36	10.39
May	10.49	10.37	10.34	10.37
June	10.39	10.31	10.31	10.31

Sheetings

48x40	36 in.	5.50	lb.	— @	.05
40x40	36 in.	6.15	lb.	— @	.04¾
40x36	36 in.	6.50	lb.	— @	.04½
48x48	40 in.	2.50	lb.	— @	.09¼
48x48	40 in.	2.85	lb.	— @	.08⅝
56x60	40 in.	3.60	lb.	— @	.08⅜
48x44	40 in.	3.75	lb.	— @	.07⅞

Ducks

Enameling (single filling)	lb. .29	@	.30
Belting and Hose	lb. .29	@	—
Single filling, A grade	lb. .13¾	@	.13½
Double filling	lb. .14	@	.15

Closing Rubber Prices on New York Commodity Exchange, Inc.

No. 1 Standard Contract of 10 Tons

FROM JANUARY 14 TO FEBRUARY 10

Date	Spot	Jan.	Feb.	Mar.	Apr.	May	Sales
Jan. 14	20.00	19.88	19.88	19.89	19.82	19.75	71
15	19.70	19.67	19.67	19.67	19.63	19.60	60
16	19.70	19.64	19.66	19.68	19.61	19.55	54
17	19.70	19.59	19.61	19.63	19.56	19.50	4
18	19.62	19.48	19.50	19.52	19.46	19.41	16
19	—	—	—	—	—	—	—
20	19.50	19.31	19.33	19.35	19.30	19.26	36
21	19.20	19.10	19.10	19.10	19.05	19.00	92
22	19.20	19.00	19.00	19.00	18.96	18.90	63
23	19.25	19.10	19.10	19.10	19.05	19.01	27
24	19.37	19.27	19.27	19.27	19.23	19.20	42
25	19.50	19.42	19.42	19.42	19.36	19.30	9
26	—	—	—	—	—	—	—
27	19.40	19.36	19.36	19.36	19.31	19.25	16
28	19.56	19.45	19.45	19.45	19.41	19.37	22
29	19.62	—	19.61	19.61	19.55	19.50	41
30	19.75	—	19.80	19.80	19.72	19.65	60
31	19.75	—	19.79	19.79	19.71	19.64	65
Feb. 1	19.75	—	19.77	19.77	19.70	19.63	2
2	—	—	—	—	—	—	—
3	19.75	—	19.80	19.80	19.72	19.63	11
4	19.75	—	19.72	19.72	19.66	19.60	88
5	19.75	—	19.80	19.80	19.73	19.67	51
6	19.87	—	19.85	19.84	19.78	19.73	64
7	19.87	—	19.85	19.85	19.79	19.72	19
8	19.90	—	19.90	19.90	19.85	19.80	42
9	—	—	—	—	—	—	—
10	20.00	—	20.02	20.02	19.97	19.92	30

CHEMICAL MARKETS

New York, Feb. 10, 1941
All Prices F.O.B. Works

ACCELERATORS

Organic

A-1 (Thiocarbanilid)	lb.	.24 @	.30
A-10	lb.	.31 @	.35
A-11	lb.	.52 @	.65
A-19	lb.	.52 @	.65
A-32	lb.	.70 @	.80
A-77	lb.	.42 @	.55
A-100	lb.	.42 @	.55
Aldehyde ammonia, crystals	lb.	.65 @	.70
Altax	lb.	.55 @	.60
Beutene	lb.	.70 @	.75
Butyl Zimate	lb.	— @	2.15
Captax	lb.	.50 @	.55
Crylene	lb.	.40 @	.47
Di-Ortho-Tolyguanidine	lb.	.44 @	.46
Diphenylguanidine	lb.	.35 @	.36
El-Sixty	lb.	.50 @	.65
Ethyl Zimate	lb.	— @	2.15
Ethylidene aniline	lb.	.42 @	.43
Formaldehyde aniline	lb.	.31 @	—
Guantal	lb.	.40 @	.50
Hepteen	lb.	.35 @	.40
Hexamethylenetetramine	lb.	.33 @	—
Lead Oleate, No. 999	lb.	.13 @	—
Witco	lb.	.15 @	—
Monex	lb.	— @	2.00
Phenex	lb.	.50 @	.55
Pip-Pip	lb.	2.50 @	—
Pipsolene	lb.	1.55 @	1.85
R & H 50-D	lb.	.42 @	.43
R-2	lb.	1.40 @	1.80
R-2 Crystals	lb.	2.50 @	2.75
R-23	lb.	.40 @	—
RN-2	lb.	1.40 @	1.80
RN-2 Crystals	lb.	2.00 @	2.25
Rotax	lb.	.60 @	.65
Safex	lb.	1.20 @	1.30
SPDX	lb.	.70 @	.75
Super-Sulphur No. 1	lb.	.50 @	—
No. 2	lb.	.18 @	.20
Thiocarbanilid, drums	lb.	.24 @	.30
Thiurad	lb.	— @	2.35
Trimene	lb.	.55 @	.65
base	lb.	1.05 @	1.20
Triphenylguanidine	lb.	.45 @	—
Tuads	lb.	— @	2.00
Ulto	lb.	1.25 @	1.75
Ureka	lb.	.60 @	.75
Blend B	lb.	.60 @	.75
Blend C	lb.	.56 @	.65
Vulcanex	lb.	.42 @	.43
Vulcanol	lb.	.85 @	—
Zimate	lb.	— @	2.00

Inorganic

Litharge, domestic	lb.	.07 @	.07½
Magnesia, calcined, heavy	lb.	.04 @	—

COLORS

Blacks (See Next Column)

Blues

Prussian	lb.	.33 @	—
Ultramarine	lb.	.11 @	.16

Browns

Mapico	lb.	.11 @	—
Umber, Turkey	lb.	.04½ @	.05

Greens

Chrome	lb.	.21 @	.30
Guignet's Green	lb.	.70 @	—

Reds

Antimony crimson, 15/17	lb.	— @	—
sulfur, free	lb.	— @	—
Indian	lb.	.08¾ @	—
Domestic (Maroon)	lb.	.11 @	—
Mapico	lb.	.09¾ @	—
Red oxide, pure	lb.	.10 @	.12
Rub-Er-Red	lb.	.09¾ @	—

Whites

Cryptone No. 19	lb.	.05¼ @	.05½
Cryptone CB No. 21	lb.	.05¼ @	.05½
Cryptone ZS-86	lb.	.07¾ @	.08
Cryptone ZS-230	lb.	.07¾ @	.08
Cryptone ZS-800	lb.	.07¾ @	.08
Lithopone:			
Albalith	lb.	.0385 @	.0410
Azolith	lb.	.0385 @	.0410
Ray-bar	lb.	.05½ @	.05¾
Ray-cal	lb.	.05¼ @	.05¾
Rayox	lb.	.13½ @	.14¼
Titanox A	lb.	.13½ @	.13¾
Titanox B	lb.	.05½ @	.05¾
Titanox C	lb.	.05¼ @	.05½

Zinc Oxide—American Process

American Azo:			
ZZZ (lead free)	lb.	.06½ @	.06¾
Anaconda, lead free	lb.	.06½ @	.06¾
Horsehead Lead Free Brand:			
Special—3	lb.	.06½ @	.06¾
XX Red—4	lb.	.06½ @	.06¾
XX Red—72	lb.	.06½ @	.06¾
XX Red—78	lb.	.06½ @	.06¾
XX Red—103	lb.	.06½ @	.06¾
Kadox, black label—15	lb.	.06½ @	.06¾
Red label—17	lb.	.06½ @	.06¾
St. Joe, black label	lb.	.06½ @	.06¾
green label	lb.	.06½ @	.06¾
red label	lb.	.06½ @	.06¾
U. S. P.—7, bbls.	lb.	.09½ @	.09¾

Zinc Oxide—French Process:

Florence White Seal—7 bbls.	lb.	.08½ @	.08¾
Green seal—8	lb.	.08 @	.08¼
Red seal—9	lb.	.07½ @	.07¾

Yellows

Cadmolith	lb.	.50 @	.55
Chrome	lb.	.13½ @	.18½
Mapico	lb.	.06¾ @	—

BLACKS
(In bags, carload lots)

Aerfloted Arrow	lb.	.02925 @	—
Certified	lb.	.02925 @	—
Certified Spheron	lb.	.02925 @	—
Continental	lb.	.02925 @	—
Disperso	lb.	.02925 @	—
Dixiedensed	lb.	.02925 @	—
Dixiedensed 66	lb.	.02925 @	—
Excello	lb.	.02925 @	—
Fumonex	lb.	.03 @	—
Fumonex Beads	lb.	.03 @	—
Gastex	lb.	.03 @	—
Kosmobile	lb.	.02925 @	—
Kosmobile 66	lb.	.02925 @	—
Micronex (Amarillo)	lb.	.02925 @	—
Micronex Beads (Amarillo)	lb.	.02925 @	—
Pelletex	lb.	.03 @	—
P-33	lb.	.0475 @	—
Supreme	lb.	.02925 @	—
Thermax	lb.	.02 @	—
Wyex	lb.	.02925 @	—

COMPOUNDING MATERIALS

Aluminum Flake	ton	21.85 @	24.50
Asbestine	ton	14.00 @	16.00
Barium carbonate (98-100%)	ton	47.00 @	49.00
Barytes	ton	22.85 @	31.50
Bentonite	ton	11.00 @	16.00
Blanc fixe, dry	ton	50.00 @	62.50
Calcene	ton	37.50 @	43.00
Catalpo (fact.)	lb.	.02 @	—
Chalk, precipitated			
Suprex white, extra lt.	ton	45.00 @	60.00
heavy	ton	45.00 @	55.00
Clay, Aerfloted, Suprex	ton	10.00 @	22.00
Crown (f.o.b. plant)	ton	10.00 @	—
Dixie	ton	10.00 @	22.50
Langford	ton	— @	7.50
McNamee	ton	10.00 @	22.50
Par	ton	10.00 @	22.50
Witco	ton	10.00 @	—
Cotton Flock (Dark)	lb.	.10½ @	.13
Kalite No. 1	ton	24.00 @	50.00
Kalite No. 3	ton	34.00 @	60.00
Kalvan	ton	95.00 @	121.00
Magnesium carbonate	lb.	.06¼ @	.09¾
Mica	ton	35.00 @	44.00
Mineralite	ton	— @	30.00
Pyrax A	ton	6.50 @	20.00
Rottenstone (powd. Dom.)	ton	25.50 @	37.50
Silene (calcium silicate)	lb.	.04 @	.045
Starch, powdered	cwt.	2.90 @	4.10
Talc, domestic	ton	17.00 @	25.00
Whiting, commercial	ton	16.00 @	26.00
Columbia Filler	ton	9.00 @	14.00
Witco	ton	6.00 @	—
Wood Flour	ton	24.00 @	25.00

MINERAL RUBBER

285°-300° Mineral Rubber	ton	23.00 @	42.00
Black Diamond	ton	25.00 @	—
Genasco, solid (factory)	ton	— @	—
Hard Hydrocarbon	ton	23.00 @	—
Parmr, solid	ton	— @	—
Pioneer, MR, solid	ton	— @	—

MISCELLANEOUS

Aromatics—Rodo #0	lb.	3.50 @	4.00
Rodo #10	lb.	4.50 @	5.00
Curodex 19	lb.	2.75 @	—
Curodex 188	lb.	3.50 @	—
Curodex 198	lb.	4.50 @	—
Para-Dors	lb.	4.50 @	—
Aresklene No. 375 (dispersing, wetting and penetrating agent)	lb.	.35 @	.50
Darvan (dispersing agent)	lb.	.30 @	.39
Santomerse S (dispersing, wetting, penetrating and stabilizing agent)	lb.	.11 @	.25
Sponge Paste	lb.	— @	.18
Sunproof	lb.	.22 @	.27
Tackol (tackifier)	lb.	.085 @	.18
Tonox	lb.	.52 @	.61
Ty-Ply R (and S)	gal.	6.75 @	8.75
Unicel (blowing agent)	lb.	.50 @	—

SOFTENERS

Acids

Acetic, 28%, bbls.	100 lb.	2.23 @	2.48
Nitric, 36 degrees	cwt.	5.00 @	5.95

Acids, Fatty

Laurex	lb.	.10½ @	.12¾
SL #10	lb.	.12 @	.14
Stearex Beads	lb.	.08 @	.09
Stearic, double pressed	lb.	.12½ @	.13½
Stearite	lb.	.08 @	—

Alkalies

Caustic Soda, 76%	cwt.	2.30 @	3.55
Soda Ash, 58%	cwt.	1.10 @	2.93

Oils

Cycline Oil	gal.	.14 @	.20
Degras, bbls.	lb.	.08 @	.08½
Fluxrite	lb.	.05½ @	.06½
Para-Flux	gal.	.08½ @	.18
Para-Lube	lb.	.425 @	.48
Petrolatum, amber	lb.	.02¾ @	.03¾
Pigmentaroil, tank cars	gal.	.16 @	—
in drums	gal.	.22½ @	.23½
Pine, steam distilled	gal.	.54 @	.59
Rosin Oil, cmpd.	gal.	.40 @	—
Rubberol	lb.	.13½ @	.14
Rubtack	lb.	.10 @	—
Seedine, c.l.	lb.	.07¼ @	—
Tackol	lb.	.08½ @	.18
Witco Palm Oil	lb.	— @	—
Witco Softener No. 20	gal.	.20 @	—
Woburn No. 8, c.l.	lb.	.06 @	—

Resins and Pitches

Pitch, Burgundy	lb.	.06 @	.06½
coal tar	ton	19.00 @	22.00
hardwood	ton	16.00 @	22.50
pine, 200 lb. gr. wt. bbl.		6.00 @	6.50
Pigmentar, tank cars	gal.	.16 @	—
in drums	gal.	.22½ @	.23½
R. S. L. Resin	lb.	— @	—
Retort Pine Tar, drums	ton	20.00 @	26.00

Solvents

Acetone, pure	lb.	.06 @	.08
Benzene, 90%, tank car	gal.	.14 @	—
Beta-Trichlorethane	gal.	— @	.20
Bondogen	lb.	.98 @	1.25
Carbon, bisulfide	lb.	.05 @	.08½
Carbon tetrachloride	gal.	.66½ @	1.17
Dichlorethylene	lb.	— @	—
Dipentene, cml., drums	gal.	.38 @	.50
Ethylene dichloride	lb.	.07 @	.08
Plastogen	lb.	.07¾ @	.12
Reogen (drums)	lb.	.11½ @	.23
Rub-Sol	gal.	.09½ @	—
Trichlorethylene	lb.	.08 @	.09½
Turpentine, spirits	gal.	.44 @	.48
dest. dist., drums	gal.	.30 @	.35

Waxes

Beeswax, white	lb.	.36½ @	.38½
Carnauba, yellow	lb.	.69 @	.70½
Ceresin, white, dom	lb.	.11½ @	—
Montan, crude	lb.	— @	—

Paraffin (c.l.—f.o.b. N. Y.)

Yellow crude scale, 122/124	lb.	.02¾ @	—
Refined, 123/125	lb.	.05¾ @	—

ANTI-OXIDANTS

Agerite Alba	lb.	2.00 @	2.15
Exel	lb.	1.00 @	1.02
Gel	lb.	.57 @	.59
Hipar	lb.	.65 @	.67
Powder	lb.	.52 @	.54
Resin	lb.	.52 @	.54
Resin D	lb.	.52 @	.54
White	lb.	1.25 @	1.60
Albasan	lb.	.70 @	.75
Antox	lb.	— @	.56
B-L-E	lb.	.52 @	.61
Flectol B	lb.	.52 @	.65
Flectol H	lb.	.52 @	.65
Flectol White	lb.	.90 @	1.15
Neozone A, B, C, D, E	lb.	.52 @	.63
Oxynone	lb.	.64 @	.80
Retardex	lb.	.45 @	.48
Santoflex B	lb.	.52 @	.65
Santovar A	lb.	1.15 @	1.40
S.C.R.	lb.	.33 @	.35
Stabilite	lb.	.52 @	.54
Stabilite Alba	lb.	.70 @	.75
VGB	lb.	.52 @	.61

MOLD LUBRICANTS

Aresklene	lb.	.35 @	.50
Cocoa Soapstock	lb.	.06 @	.08
Dipex	lb.	.06 @	.08
Lubrex	lb.	.25 @	.30
Mineralite	ton	— @	30.00
Mold Paste	lb.	.12 @	.18
Rubberol	lb.	.13½ @	.14
Sericite	ton	65.00 @	75.00
Soap Tree Bark, cut, sifted	lb.	.06 @	.08

FACTICE OR RUBBER SUBSTITUTES

Amberex	lb.	.25 @	—
Amberex Type B	lb.	.18¾ @	—
Black	lb.	.08 @	.12
White	lb.	.08½ @	.13½
Brown	lb.	.08 @	.11½
Neophax A	lb.	.09 @	—

VULCANIZING INGREDIENTS

Dispersed Sulfur No. 2	lb.	.07½ @	.15
Sulfur Chloride, yellow (drs.)	lb.	.035 @	.04
Sulfur, rubber makers			
Refined (bags)	cwt.	2.35 @	—
Commercial (bags)	cwt.	2.00 @	—
Telloy	lb.	1.75 @	—
Vandex	lb.	1.75 @	—

STATISTICS

Crude Rubber — Latex & Guayule — Reclaim — Tires & Tubes — Automobiles — Rims — Gasoline — Cotton Prices

U. S. Imports and Exports of Crude Rubber

YEARS	Gross Imports: Long Tons	Gross Imports: Total Declared Value	Gross Imports: Average Declared Value per pound Cents	Re-exports: Long Tons	Re-exports: Total Declared Value	Re-exports: Average Declared Value per pound Cents	Net Imports: Long Tons
1924	325,899	173,367,272	23.75	10,309	6,057,637	26.23	315,590
1925	393,370	426,167,504	48.36	14,827	19,847,753	59.76	378,543
1926	409,944	501,131,064	54.57	17,671	22,470,583	56.77	392,273
1927	424,733	338,688,492	35.60	27,775	24,735,488	39.76	396,958
1928	432,633	242,727,433	25.05	32,159	18,128,761	25.17	400,474
1929	560,082	239,177,811	19.06	36,485	16,868,718	20.64	523,597
1930	482,083	139,133,048	12.88	30,205	9,310,205	13.76	451,878
1931	497,176	72,922,845	6.55	25,595	4,255,572	7.42	471,581
1932	409,556	31,936,459	3.48	20,930	2,015,612	4.30	388,626
1933	407,817	44,034,064	4.82	20,537	2,601,352	5.65	387,280
1934	449,513	97,929,676	9.73	23,848	5,770,109	10.80	425,665
1935	453,134	115,299,448	11.36	11,389	3,084,331	12.09	441,745
1936	467,064	152,072,496	14.54	12,581	4,488,223	15.93	454,483
1937	574,600	237,307,041	18.44	7,902	3,385,433	19.02	566,698
1938	397,620	125,357,730	14.07	5,652	1,799,124	14.21	391,968
1939	469,803	167,558,245	15.92	13,125	5,832,618	19.84	456,678
1939:							
Sept.	35,906	12,667,740	16.16	1,472	659,055	19.98	33,534
Oct.	42,784	15,211,621	15.87	5,886	2,881,172	21.85	36,898
Nov.	39,422	14,555,150	16.48	1,228	539,763	19.63	38,194
Dec.	68,384	25,861,354	16.88	1,116	529,759	21.20	67,268
1940:							
Jan.	68,962	26,314,500	17.03	955	447,673	20.92	68,007
Feb.	40,603	15,578,517	17.13	1,291	599,819	20.74	39,312
Mar.	55,517	21,845,290	17.57	975	447,460	20.49	54,542
April	66,622	26,176,442	17.54	565	252,638	19.98	66,057
May	47,559	18,511,955	17.38	821	301,914	16.41	46,738
June	51,074	20,019,581	17.50	621	295,334	21.15	50,451
July	66,931	26,426,632	17.63	100	49,828	22.20	66,831
Aug.	70,453	27,608,883	17.49	416	183,369	19.69	70,037
Sept.	75,770	29,317,540	17.27	666	349,443	23.43	75,104
Oct.	73,179	27,975,598	17.07	316	123,216	17.38	72,863
Nov.	69,844	26,917,136	17.21	126	52,020	18.45	69,718

Note: "Gross Imports" do not include latex or guayule. To secure more accurate figures for "Net Imports" latex and guayule figures (shown below) should be added and the re-export figure deducted from the total. Annual figures for 1924-36 were revised in February, 1937.

United States Imports of Guayule, Balata, Jelutong, Liquid Latex

(All Quantities in Long Tons)

	Guayule: Tons	Guayule: Dollars	Balata: Tons	Balata: Dollars	Jelutong: Tons	Jelutong: Dollars	Liquid Latex (1): Tons	Liquid Latex (1): Dollars
1924	1,356	536,392	464	568,456	6,165	1,237,100	2,157	864,059
1925	3,781	1,803,448	517	574,750	6,749	1,642,531	3,272	3,537,510
1926	4,305	2,562,096	354	327,213	7,263	3,127,757	3,394	4,686,743
1927	5,018	2,674,957	582	477,246	7,785	2,448,657	1,495	1,170,650
1928	3,077	1,755,685	731	430,855	7,552	2,540,059	4,007	2,121,786
1929	1,275	545,175	728	566,964	8,204	2,458,126	3,729	1,788,391
1930	1,096	347,388	502	422,684	5,907	1,403,244	4,458	1,508,786
1931	....	.....	1,207	411,380	5,777	1,019,010	4,675	888,909
1932	....	.....	707	147,403	4,607	616,596	5,112	601,999
1933	...	.....	1,659	2,261,869	5,990	944,895	11,085	1,833,671
1934	398	75,349	1,054	438,209	4,987	943,752	13,107	3,643,221
1935	459	86,835	615	188,384	5,644	1,063,126	13,553	3,782,222
1936	1,229	286,552	535	199,368	6,163	1,296,364	19,852	6,659,899
1937	2,694	745,873	354	151,344	7,109	2,017,786	23,185	10,213,670
1938	2,485	623,819	509	181,140	9,132	2,944,504	11,878	4,147,318
1939	2,232	463,345	694	265,553	6,640	1,603,418	27,438	10,467,552
1939:								
Sept.	133	30,091	36	19,682	479	100,285	2,525	965,615
Oct.	282	61,376	107	43,267	465	127,084	2,555	968,207
Nov.	214	46,558	96	37,858	289	74,358	3,071	1,227,788
Dec.	236	51,521	64	38,781	477	126,548	2,779	1,127,924
1940:								
Jan.	128	27,901	34	19,478	612	155,570	3,410	1,412,728
Feb.	314	70,251	55	26,420	461	134,878	2,171	947,524
Mar.	365	81,181	45	20,895	542	162,493	3,376	1,473,056
April	314	65,313	50	18,289	506	176,064	3,763	1,608,156
May	289	57,578	60	20,503	495	158,713	3,584	1,523,879
June	365	74,957	47	10,977	390	146,196	2,451	1,004,007
July	262	53,058	65	20,553	336	115,599	2,281	993,411
Aug.	297	59,464	61	22,638	701	276,642	2,278	1,022,531
Sept.	250	49,845	40	19,245	712	246,641	2,953	1,337,487
Oct.	381	77,286	70	38,092	1,150	382,168	1,156	512,153
Nov.	392	78,587	67	43,939	445	152,297	2,308	1,169,086

(1) Weight given in pounds of dry rubber contained in latex.

Note: Annual figures for 1924-1936 revised on basis of information received on February 8, 1937.

U. S. Consumption of Crude Rubber

(Including Latex)

	1933	1934	1935	1936	1937	1938	1939	1940
	Figures on Monthly Basis							
Jan.	22,645	39,190	46,636	48,631	50,879	31,265	47,387	54,978
Feb.	21,392	40,515	42,720	36,841	51,950	25,357	43,422	49,832
Mar.	17,843	47,003	42,153	42,813	54,129	32,389	51,416	50,192
Apr.	25,928	44,853	44,247	52,031	51,859	29,730	45,268	50,103
May	44,074	42,918	41,101	50,612	51,795	30,753	45,484	51,619
June	50,743	40,147	36,156	52,772	51,660	32,540	48,438	46,506
July	49,614	32,553	35,917	48,250	43,703	34,219	44,975	47,011
Aug.	44,428	33,216	38,775	46,777	41,506	40,552	51,740	50,234
Sept.	35,281	30,258	37,086	46,449	43,945	40,183	51,402	50,206
Oct.	31,543	31,253	41,969	49,637	38,754	42,850	57,155	56,477
Nov.	28,831	34,748	42,310	50,453	34,025	49,050	55,677	54,652
Dec.	28,757	36,569	42,474	49,754	29,195	48,143	49,636	56,539
Tot.	401,079	453,223	491,544	575,000	543,600	437,031	592,000	618,349

Note: The above figures are based on the annual surveys conducted by the Leather and Rubber Division, Bureau of Foreign & Domestic Commerce, Washington, D. C., with the exception of those for the current year which are estimates made by the Rubber Manufacturers Association. They are revised frequently and the latest available issue should always be consulted for the most reliable figures.

Reclaimed Rubber in the United States

(All Quantities in Long Tons)

Year	Production	Consumption: Tons	Consumption: % to Crude	Stocks	Year	Production	Consumption: Tons	Consumption: % to Crude	Stocks
1931	129,690	123,000	35.1	21,714	1936	150,571	141,486	24.6	19,000
1932	75,656	77,500	23.3	16,334	1937	185,033	162,000	29.8	28,800
1933	93,587	85,000	21.2	17,780	1938	122,400	120,800	29.9	23,000
1934	108,162	100,855	22.3	20,000	1939	186,000	170,000	28.7	25,250
1935	122,948	117,523	23.9	17,000	1940	209,601	187,090	30.3	34,701
	Figures on Monthly Basis								
1939									
Jan.	13,870	12,633	26.7	22,350	July	11,777	12,443	27.7	21,269
Feb.	13,193	12,269	28.3	22,644	Aug.	16,461	15,485	29.9	21,402
Mar.	14,638	14,888	29.0	21,638	Sep.	16,830	15,583	30.3	21,384
Apr.	13,591	12,309	27.3	22,172	Oct.	19,549	17,423	30.5	21,694
May	13,817	12,425	27.3	22,556	Nov.	19,417	16,551	29.7	23,239
June	14,848	13,669	28.2	22,976	Dec.	18,009	14,317	26.8	25,250
1940:									
Jan.	19,297	16,070	29.2	27,418	July	14,342	14,298	30.4	28,058
Feb.	17,992	15,370	30.8	28,603	Aug.	17,213	14,224	28.3	29,786
Mar.	17,234	15,931	31.7	28,488	Sep.	16,428	14,589	29.1	30,287
Apr.	16,568	16,298	32.5	27,558	Oct.	19,358	16,528	29.3	32,118
May	17,552	15,719	30.5	28,397	Nov.	17,689	16,042	29.4	33,143
June	16,631	14,912	32.1	29,260	Dec.	19,297	17,109	30.3	34,701

Note: The above figures are based on the annual surveys conducted by the Leather and Rubber Division, Bureau of Foreign & Domestic Commerce, Washington, D. C., with the exception of those for the current year which are estimates made by the Rubber Manufacturers Association. They are revised frequently and the latest available issue should always be consulted for the most reliable figures. The annual figures are more accurate. Stocks shown are those on hand at the end of the indicated month or year.

U. S. Consumption of Gasoline

(Bureau of Mines Statistics)

(In Thousands of Barrels of 42 Gallons)

	1938	1939*	1940		1938	1939*	1940
January	35,323	38,089	40,370	August	50,549	54,025	55,346
February	31,981	34,928	37,557	September	46,150	49,505	52,297
March	41,409	43,042	44,607	October	46,365	49,854	53,807
April	43,430	44,264	47,683	November	45,084	47,407	49,074
May	44,937	49,766	52,946	December	41,742	43,807	46,413
June	48,383	50,133	55,459				
July	47,650	50,689	53,865	Total	523,003	555,509	589,424

* Revised.

Rims Inspected and Passed in U. S.

(Tire and Rim Association Reports)

	Total		Total		Total
1929	24,141,502	1933	8,713,962	1937	22,257,964
1930	17,364,096	1934	12,255,118	1938	10,612,138
1931	11,253,800	1935	18,664,107	1939	17,471,914
1932	6,261,336	1936	20,790,194	1940	19,378,558
1940		1940		1940	
January ...	2,163,914	May	1,743,786	September .	1,355,924
February ..	1,850,383	June	1,266,300	October ...	1,759,102
March	1,918,241	July	825,089	November ..	1,807,950
April	1,822,686	August	1,075,469	December ..	1,789,914

Daily Spot Closing Prices of Ribbed Smoked Sheet Rubber—*New York Market, in Cents per Pound*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Ave.
1938																																
Oct.	16¼	16¼	16¼	16¼	17	16¼	16¼	17⅛	17⅛	17⅛	17⅛	—	16¼	17⅛	17⅛	—	16⅝	16¼	16⅝	16¼	16⅝	16¼	16⅛	16¼	16¼	16¼	16¼	16¼	—	16¼	16⅜
Nov.	16¼	16¼	16¼	16¼	16¼	15⅞	15⅞	15⅞	15⅞	16	—	15⅞	15⅞	16⅝	16⅝	16	16⅝	15⅞	16	16⅛	16⅝	16⅛	15⅝	—	15⅝	15⅝	15⅝	15⅝	15⅝	16	16⅛
Dec.	15⅞	15¼	15⅛	—	15¼	15⅛	15⅛	15⅛	15⅛	—	—	—	—	—	15⅛	15⅛	15⅛	—	—	—	—	—	—	—	—	—	16⅛	15⅝	16¼	16⅛	16
1939																																
Jan.	—	—	16⅛	16⅞	16	16	—	—	15⅛	—	15⅛	15⅜	15⅛	15⅜	15⅜	15⅞	15⅜	15⅛	15⅛	15⅜	15⅜	—	15⅞	15⅜	15½	14⅛	15⅞	—	15⅞	15¾	15¾
Feb.	15⅝	15⅝	15¾	15⅛	—	15⅛	15⅛	15⅛	15¾	16	15⅞	16⅛	—	16	16⅛	16⅛	16⅛	—	—	16⅛	16⅛	—	16⅛	16⅛	16⅛	—	16⅛	16⅛	—	15⅜	16⅛
March	16⅛	16⅛	16¾	16¼	16	16⅛	16⅛	—	16	16⅛	16⅛	16⅛	15⅞	16⅛	16⅛	16⅛	16⅛	15⅛	15⅜	15⅜	15⅜	15⅜	15⅜	15⅜	15⅜	15⅜	15⅜	15⅜	15⅜	15⅜	15⅜
April	15⅜	15⅜	16	15⅛	16	16	16	16	16	16⅛	16⅛	16⅛	16	16⅛	16⅛	16⅛	16⅛	15⅜	15⅜	15⅜	15⅜	15⅜	15⅜	15⅜	15⅜	15⅜	15⅜	15⅜	15⅜	15⅜	15⅜
May	15⅛	15⅛	15⅜	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛	15⅛
June	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛	16⅛
July	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
August	16⅞	16⅞	16⅝	16⅛	16⅝	16⅝	16⅝	16⅝	16⅝	16⅝	16⅝	16⅝	16⅝	16⅝	16⅝	16⅝	16⅝	16⅝	16⅝	16⅝	16⅝	16⅝	16⅝	16⅝	16⅝	16⅝	16⅝	16⅝	16⅝	16⅝	16⅝
September	18¾	18¾	18¾	—	24	21½	19½	20	22	23	—	—	22¾	19¾	22	22	22	20¾	20¾	21½	20½	20¾	21¾	21¾	21¾	21¾	21¾	21¾	21¾	21¾	21¾
October	20	20	19½	19¼	19½	20½	20½	—	19¼	20	20	20	20½	20¾	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
November	20⅛	20⅛	20¼	20⅛	20⅛	20⅛	20⅛	20⅛	20⅛	20⅛	20⅛	20⅛	20⅛	20⅛	20⅛	20⅛	20⅛	20⅛	20⅛	20⅛	20⅛	20⅛	20⅛	20⅛	20⅛	20⅛	20⅛	20⅛	20⅛	20⅛	20⅛
December	20	20	—	19¾	19¾	19¾	19¾	19¾	19¾	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1940																															
January	19¾	19¾	19¾	19¾	19¾	19¾	—	19¾	19¾	19¾	19½	19¾	19¾	—	19¾	19¾	19¾	19¾	19¾	19¾	—	19¾	—	19¾	19¾	19¾	19½	19½	19½	19½	19½
February	18¾	18¾	18¾	18¾	18¾	18¾	18¾	19¾	19¾	19¾	18¾	18¾	18½	—	18½	18½	18½	18¾	18¾	18¾	—	18¾	—	18¾	18¾	—	18¾	18¾	18¾	18¾	18¾
March	18⅞	18⅞	18⅝	18⅛	18⅛	18⅛	18⅛	18⅛	19	18⅞	18⅞	18¾	18⅜	19	19	19⅜	19⅜	20	20	20	21¼	23	19½	20	20	20	20	20	19½	19½	19½
April	19⅛	19⅛	18½	18⅝	18⅝	18⅛	18⅛	18⅛	18⅝	18⅝	18⅝	18⅝	18⅜	18⅝	18⅝	18⅝	18⅝	18⅝	18⅝	18⅝	18⅝	18⅝	18⅝	18⅝	18⅝	18⅝	18⅝	18⅝	18⅝	18⅝	18⅝
May	19⅜	19⅜	20	20⅝	20⅝	20⅝	20	20⅝	20⅝	24	23½	23½	23¼	24	23½	22½	22⅝	22⅝	22⅝	22⅝	22⅝	22⅝	22⅝	22⅝	22⅝	22⅝	22⅝	22⅝	22⅝	22⅝	22⅝
June	20⅝	20⅝	21½	21½	21¾	21¾	21⅜	21¾	20⅝	22½	23½	22¾	22¾	22½	20½	21	22⅝	22⅝	22⅝	22⅝	22⅝	22⅝	22⅝	22⅝	22⅝	22⅝	22⅝	22⅝	22⅝	22⅝	22⅝
July	21½	21½	21½	—	—	—	—	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝
August	19⅞	19⅞	20	21½	19⅞	19⅞	19¾	19⅝	19⅝	19⅝	19⅝	19⅝	19½	19⅝	19⅝	19⅝	19⅝	19⅝	19⅝	19⅝	19⅝	19⅝	19⅝	19⅝	19⅝	19⅝	19⅝	19⅝	19⅝	19⅝	19⅝
September	—	—	19⅜	19⅜	19⅜	19⅜	19⅜	19⅜	19⅜	19⅜	19⅜	19⅜	19⅜	19⅜	19⅜	19⅜	19⅜	19⅜	19⅜	19⅜	19⅜	19⅜	19⅜	19⅜	19⅜	19⅜	19⅜	19⅜	19⅜	19⅜	19⅜
October	19⅝	19⅝	19⅜	19¾	19⅞	19⅝	19⅝	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝	20⅝
November	20⅝	20⅝	20⅝	—	—	—	—	20⅝	21⅝	21	21	21	21½	21	21½	21½	21¼	21¼	21¼	21¼	21¼	21¼	21¼	21¼	21¼	21¼	21¼	21¼	21¼	21¼	21¼
December	20	20	—	—	19⅞	19⅞	19⅞	20⅛	20⅛	20	20	20	20⅛	20⅛	20⅛	20⅛	20⅛	20⅛	20⅛	20⅛	20⅛	20⅛	20⅛	20⅛	20⅛	20⅛	20⅛	20⅛	20⅛	20⅛	20⅛
1941																															
January	20⅛	—	20½	20½	—	20½	20⅜	20⅜	20¼	20⅛	20⅛	—	20⅛	20	19⅞	19⅞	19⅞	19⅞	19⅞	19¾	19¼	19⅛	19⅛	19⅛	19⅛	—	19½	—	19½	19⅝	19⅝
February	—	—	19⅞	19⅞	19⅞	19⅞	19⅞	19⅞	—	20	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Average Spot Closing Prices—Ribbed Smoked Sheets

(New York Markets)

Average Price per Pound for Years 1913-1932

Year	Cents	Year	Cents	Year	Cents	Year	Cents	Year	Cents
1914	65.33	1918	60.15	1922	17.50	1926	48.50	1930	11.9
1915	65.85	1919	48.70	1923	29.45	1927	37.72	1931	6.1
1916	72.50	1920	36.30	1924	26.20	1928	22.48	1932	3.4
1917	72.23	1921	16.36	1925	72.46	1929	20.59	1933	5.9

Average Monthly Price per Pound Since 1933

	1934 Cents	1935 Cents	1936 Cents	1937 Cents	1938 Cents	1939 Cents	1940 Cents	1941 Cents
Jan.	9.32	13.10	14.35	21.37	14.63	15.75	19.06	19.83
Feb.	10.45	12.92	15.48	21.33	14.71	15.93	18.83	
Mar.	11.01	11.51	15.89	24.09	13.55	16.26	18.58	
Apr.	12.10	11.55	15.98	23.44	11.84	15.87	19.16	
May	13.26	12.05	15.62	21.14	11.57	16.07	21.21	
June	13.51	12.57	15.85	19.29	12.57	16.37	22.20	
July	14.60	12.10	16.49	18.86	15.37	16.51	21.12	
Aug.	15.47	11.98	16.25	18.37	16.08	16.67	19.62	
Sept.	15.36	11.55	16.46	18.55	16.15	21.24	19.28	
Oct.	13.96	12.62	16.55	16.28	16.89	19.89	20.33	
Nov.	13.04	13.15	17.97	14.60	16.24	20.21	21.04	
Dec.	12.98	13.28	20.01	15.41	16.05	20.01	20.76	
Average for Year	12.92	12.37	16.41	19.39	14.64	17.57	20.10	

London Closing Prices of Ribbed Smoked Sheets

(In Pence Per Pound)

Day	1940 Nov.	1940 Dec.	1941 Jan.	1941 Feb.	Day	1940 Nov.	1940 Dec.	1941 Jan.	1941 Feb.
1	11 13/16	—	—	—	17	—	11 13/16	12 1/16	
2	—	11 3/4	12 1/16	—	18	11 7/8	12	—	
3	—	11 13/16	12 3/16	12 1/16	19	11 13/16	12	—	
4	11 3/4	11 7/8	—	12 1/16	20	11 7/8	11 13/16	12 3/16	
5	11 13/16	11 7/8	—	12 1/16	21	11 13/16	—	12 1/16	
6	11 13/16	11 7/8	12 3/16	12 1/16	22	11 3/4	—	12 3/16	
7	11 13/16	—	12 1/2	12 1/16	23	—	11 13/16	12 3/16	
8	11 13/16	—	12 1/2	—	24	—	12	12 1/16	
9	—	11 7/8	12 7/16	—	25	11 13/16	—	—	
10	—	11 13/16	12 7/16	12 7/16	26	11 13/16	—	—	
11	11 13/16	12	—		27	11 13/16	12	12 1/2	
12	11 7/8	12	—		28	11 3/4	—	12 1/2	
13	11 7/8	12 1/16	12 7/16		29	11 3/4	—	12 1/2	
14	11 13/16	—	12 3/8		30	—	12 1/8	12 1/2	
15	11 13/16	—	12 3/8		31	—	12 1/16	12 1/16	
16	—	12 1/16	12 1/4						

Average Monthly Price Per Pound

Month	1938 Pence	1939 Pence	1940 Pence	1941 Pence	Month	1938 Pence	1939 Pence	1940 Pence	1941 Pence
Jan.	7.077	7.926	11.793	12.415	Aug.	7.841	8.545	12.818	
Feb.	7.029	7.942	12.577		Sept.	7.918	9.634	11.964	
Mar.	6.590	8.120	11.651		Oct.	8.355	10.177	11.813	
Apr.	5.793	7.910	10.980		Nov.	8.111	11.210	11.801	
May	5.632	8.002	11.600		Dec.	8.005	11.559	11.963	
June	6.147	8.216	13.046		Average for Year	7.164	8.959	12.035	
July	7.464	8.271	12.410						

Note: No quotations were made in the London market from June 17 through June 30. Accordingly, the average for the month is based on the first eleven trading days only.

Spot Closing Cotton Prices

(Middling Upland Grade—New York Market)

Recent Daily Price Per Pound

Date	1940 Dec.	1941 Jan.	1941 Feb.	Date	1940 Dec.	1941 Jan.	1941 Feb.	Date	1940 Dec.	1941 Jan.	1941 Feb.
1	—	—	10.90	11	10.11	10.59		22	—	10.69	
2	10.96	10.42	—	12	10.12	—		23	10.12	10.85	
3	10.13	10.43	10.91	13	10.20	10.53		24	10.14	10.94	
4	10.17	10.41	10.87	14	10.17	10.45		25	—	10.89	
5	10.19	—	10.86	15	—	10.51		26	10.18	—	
6	10.23	10.58	10.91	16	10.15	10.60		27	10.26	10.87	
7	10.18	10.60	10.89	17	10.16	10.62		28	10.30	10.88	
8	—	10.62	10.92	18	10.14	10.59		29	—	10.80	
9	10.18	10.61	—	19	10.13	—		30	10.40	10.86	
10	10.17	10.63	10.94	20	10.13	10.57		31	10.43	10.92	
				21	10.16	10.57					

Average Monthly Price Per Pound

	1938 Cents	1939 Cents	1940 Cents	1941 Cents		1938 Cents	1939 Cents	1940 Cents	1941 Cents
Jan.	8.57	8.94	11.19	10.66	Aug.	8.41	9.30	9.84	
Feb.	8.91	8.97	11.10		Sept.	8.17	9.30	9.69	
Mar.	8.92	9.00	10.90		Oct.	8.61	9.24	9.62	
Apr.	8.76	8.87	10.89		Nov.	9.08	9.73	9.97	
May	8.50	9.56	10.33		Dec.	8.72	10.97	10.18	
June	8.38	9.88	10.72		Average for Year	8.66	9.46	10.40	
July	8.85	9.71	10.42						

Stocks of Crude Rubber

(All figures are in long tons)

ON HAND OR AFLOAT TO THE U. S.

End of:	ON HAND 1938	ON HAND 1939	ON HAND 1940	AFLOAT 1938	AFLOAT 1939	AFLOAT 1940	ON HAND AND AFLOAT 1938	ON HAND AND AFLOAT 1939	ON HAND AND AFLOAT 1940
Jan.	276,497	220,727	142,368	57,356	48,210	90,285	333,853	268,937	232,653
Feb.	292,067	207,882	134,328	47,459	55,814	112,257	339,526	263,696	246,585
Mar.	301,762	201,752	142,414	41,882	55,981	113,619	343,644	257,733	256,033
Apr.	303,901	188,074	162,459	39,071	57,918	102,557	342,972	245,992	265,016
May	300,907	187,980	161,446	32,859	54,046	109,364	333,766	242,026	270,810
June	294,796	173,493	168,235	32,079	51,274	119,138	326,875	224,767	287,373
July	282,785	165,450	190,222	40,400	52,990	139,629	323,185	218,440	329,851
Aug.	273 841	152,029	213,002	47,772	66,717	141,286	321,613	218,746	354,288
Sept.	268,094	136,824	241,358	48,927	68,310	137,033	317,021	205,134	378,391
Oct.	259,074	119,404	259,140	51,062	100,500	166,837	310,136	219,904	425,977
Nov.	242,592	105,205	276,943	51,114	114,044	158,095	293,706	219,249	435,038
Dec.	231,500	125,800	318,486	45,105	91,095	145,950	276,605	216,895	464,436

STOCKS IN GREAT BRITAIN

(No. of Tons in Wharves and Warehouses, not including Latex)

At end of	London 1938	London 1939	London 1940	Liverpool 1938	Liverpool 1939	Liverpool 1940
January	40,203	51,420	12,000*	21,711	28,789	8,000*
February	46,596	48,312	10,000*	24,737	26,784	7,000*
March	50,233	46,768	10,000*	26,220	24,996	8,000*
April	54,296	44,760	12,000*	28,277	23,742	10,000*
May	57,194	43,454	12,000*	29,862	22,211	9,000*
June	60,307	42,374	11,000*	31,837	21,176	8,500*
July	62,236	37,772	15,500*	32,825	19,116	11,000*
August	65,113	28,363	20,000*	34,315	16,218	16,000*
September	63,321	24,965*		34,645	14,054*	
October	59,609	23,685*		33,483	13,336*	
November	57,794	23,244*		32,116	13,087*	
December	55,668	19,545*		31,012	11,006*	

* Estimated.

(Figures up to August, 1939, from the Rubber Trade Association of London)

STOCKS IN OTHER CENTRES

(Figures from Statistical Bulletin of the Int'l Rubber Regulation Committee)

	Penang and Singapore [1]	Malaya [2]	Ceylon [2]	Holland	Para and Manaos
At end of 1939					
October	25,376*	46,264	3,335	...	3,419
November	22,957*	45,133	5,289	...	4,510
December	15,299*	54,868	5,149	...	5,336
At end of 1940					
January	35,928	60,504	5,755	....	2,862
February	33,563*	52,615	4,452	....	2,869
March	23,830*	48,180	3,369	....	3,246
April	42,239	50,656	4,749	....	2,715
May	32,731*	45,715	3,774	....	1,743
June	32,375*	45,618	5,057	....	1,706
July	36,716*	43,850	4,392	....	1,667
August	40,395*	39,950	4,460	....	1,580
September	29,069	44,730	3,549	....	2,559
October	33,638	42,239	4,060	....	3,084
November	33,778	43,693	6,258	....	....

[1] Dealers' and Port Stocks. [2] Inside Regulated Areas. [3] Dealers' Stocks Only. * Revised.

RUBBER STOCKS AFLOAT

	Afloat for United States	Afloat for Europe	All Other * Afloat	Total * Afloat
End of: 1939				
November	114,044	35,000	21,956	171,000
December	91,095	35,000	25,905	152,000
End of: 1940				
January	90,285	40,000	44,715	175,000
February	112,257	40,000	40,743	193,000
March	113,619	45,000	52,381	211,000
April	102,557	45,000	40,443	188,000
May	109,364	45,000	55,636	210,000
June	119,138	50,000	65,862	235,000
July	139,629	55,000	55,371	250,000
August	141,286	55,000	53,714	255,000
September	137,033	60,000	67,967	265,000
October	166,837	60,000	38,163	265,000
November	158,095	60,000	31,905	250,000
December	145,950	.....	.....	.....

* *Total Afloat* figures are estimated at 1½ months' world shipments by the International Rubber Regulation Committee. *All Other Afloat* is determined by subtracting the amount of stocks in transit to the United States and Europe from the estimated total.

TOTAL PRINCIPAL WORLD STOCKS

(Figures from the Survey of Current Business)

At End of:	1935	1936	1937*	1938*	1939	1940
January	698,153	600,479	454,249	549,762	497,665	433,841
February	686,195	599,355	445,265	565,833	479,578	429,551
March	678,809	583,318	447,856	586,666	460,723	447,472
April	677,006	567,172	428,249	586,291	438,252	465,345
May	677,569	541,871	413,134	568,158	429,979	470,981
June	671,525	520,255	434,250	573,136	407,640	500,774
July	679,061	519,074	445,782	580,654	418,639	547,708
August	680,644	500,520	457,462	565,394	397,345	579,119
September	661,509	493,585	470,768	551,447	396,867	631,888
October	655,000	486,159	479,398	540,976	413,274	.....
November	617,300	466,491	493,266	512,196	395,217	.....
December	613,987	466,576	545,533	482,852	391,125	.....
Monthly Avge.	666,397	528,738	460,022	555,280	427,192	.....

* Revised.

U. S. Tire and Tube Statistics[1]

(All Figures Represent Thousands)

AUTOMOBILE CASINGS

Production Figures on Quarterly Basis

Quarter	1933	1934	1935	1936	1937	1938	1939	1940
Jan.-Mar.	6,635	13,437	13,355	11,376	15,565	7,314	13,946	14,849
Apr.-June	14,412	13,565	12,597	14,892	15,834	7,380	13,759	15,711
July-Sept.	14,707	9,822	11,312	14,914	12,207	10,794	15,182	13,875
Oct.-Dec.	9,550	10,406	12,099	14,858	9,704	12,360	14,726	14,919
Total	45,304	47,230	49,363	56,040	53,310	37,848	57,613	59,354

Shipment Figures on Quarterly Basis

Quarter	1933	1934	1935	1936	1937	1938	1939	1940
Jan.-Mar.	6,981	10,730	11,154	10,554	14,143	7,388	12,445	12,728
Apr.-June	15,139	14,998	13,473	15,940	15,741	9,564	15,107	17,657
July-Sept.	13,707	11,648	13,489	14,037	13,106	11,243	15,791	13,101
Oct.-Dec.	8,265	9,310	12,066	12,855	10,495	12,098	14,165	15,670
Total	44,092	46,686	50,182	53,386	53,485	40,293	57,508	59,156

Inventory Figures [2]

Quarter	1933	1934	1935	1936	1937	1938	1939	1940
Jan.-Mar.	7,290	11,651	11,675	8,762	12,004	10,547	9,963	10,747
Apr.-June	6,615	10,219	10,755	7,556	12,081	8,337	8,632	8,881
July-Sept.	7,595	8,419	8,288	8,690	11,200	7,859	8,080	9,890
Oct.-Dec.	8,888	9,455	8,196	10,717	10,383	8,166	8,665	9,179

Figures for Recent Months

	PRODUCTION 1938	PRODUCTION 1939	PRODUCTION 1940	SHIPMENTS 1938	SHIPMENTS 1939	SHIPMENTS 1940	INVENTORY [2] 1938	INVENTORY [2] 1939	INVENTORY [2] 1940
Oct.	4,259	5,392	5,082	4,222	5,161	5,561	8,237	8,382	9,448
Nov.	4,214	4,865	4,838	4,538	4,278	5,137	7,924	8,918	9,118
Dec.	2,814	4,469	4,999	4,282	4,727	4,972	8,451	8,665	9,179

AUTOMOBILE INNER TUBES

Production Figures on Quarterly Basis

Quarter	1933	1934	1935	1936	1937	1938	1939	1940
Jan.-Mar.	6,230	12,823	12,553	11,891	15,831	7,314	12,383	12,815
Apr.-June	13,001	13,191	11,631	14,624	15,413	7,380	11,847	13,744
July-Sept.	14,356	10,321	11,270	15,320	12,038	10,794	13,118	12,469
Oct.-Dec.	9,000	9,891	12,425	15,201	9,092	12,360	13,300	13,333
Total	42,587	46,226	47,879	57,036	52,374	37,848	50,648	52,361

Shipment Figures on Quarterly Basis

Quarter	1933	1934	1935	1936	1937	1938	1939	1940
Jan.-Mar.	6,539	10,640	11,252	11,367	14,606	7,387	11,422	11,684
Apr.-June	13,292	14,553	11,928	15,113	15,495	9,564	13,010	15,003
July-Sept.	13,370	11,545	13,251	15,069	12,901	11,243	13,449	11,403
Oct.-Dec.	8,189	8,306	11,636	12,874	9,765	12,099	13,309	14,216
Total	41,390	45,044	48,067	54,423	52,767	40,293	51,190	52,306

Inventory Figures [2]

Quarter	1933	1934	1935	1936	1937	1938	1939	1940
Jan.-Mar.	6,369	10,244	10,406	8,660	11,993	10,547	8,752	8,247
Apr.-June	6,097	8,795	10,050	8,075	11,833	8,337	7,549	6,841
July-Sept.	7,008	7,639	7,565	8,595	11,326	7,859	7,206	7,950
Oct.-Dec.	7,815	9,180	8,231	10,945	10,312	8,166	7,036	7,014

Figures for Recent Months

	PRODUCTION 1938	PRODUCTION 1939	PRODUCTION 1940	SHIPMENTS 1938	SHIPMENTS 1939	SHIPMENTS 1940	INVENTORY [2] 1938	INVENTORY [2] 1939	INVENTORY [2] 1940
Oct.	3,980	5,008	4,557	4,101	4,948	4,878	7,746	7,279	7,647
Nov.	4,029	4,508	4,111	4,138	3,967	4,692	7,665	7,710	7,055
Dec.	4,351	3,784	4,665	3,859	4,394	4,646	8,166	7,036	7,014

[1] These figures are based on reports received from the Rubber Manufacturers Association. They are revised frequently and the latest available issue should be consulted for most reliable figures.
[2] Stocks held by manufacturers at end of period indicated.

Automobile Production

Year	United States Total	United States Passenger Cars	United States Trucks	Canada Total	Canada Passenger Cars	Canada Trucks	Grand Total
1929	5,358,420	4,587,400	771,020	263,295	207,498	55,797	5,621,715
1930	3,355,986	2,814,452	540,534	154,192	125,442	28,750	3,510,178
1931	2,389,730	1,973,090	416,640	82,621	63,477	19,144	2,472,351
1932	1,370,678	1,135,493	235,187	60,816	50,718	10,098	1,431,494
1933	1,920,057	1,573,512	346,545	65,924	53,855	12,069	1,992,126
1934	2,753,111	2,177,919	575,192	116,852	92,647	24,205	2,869,963
1935	3,946,934	3,252,244	694,690	172,877	135,562	37,315	4,119,811
1936	4,454,115	3,669,528	784,587	162,159	128,369	33,790	4,616,274
1937	4,808,974	3,915,889	893,085	207,463	153,046	54,417	5,016,437
1938	2,489,085	2,000,985	488,100	166,086	123,761	42,325	2,655,171
1939*	3,577,292	2,866,796	710,496	155,426	108,369	47,057	3,732,718
1940	4,469,354	3,692,328	777,026	222,984	110,126	112,858	4,692,338
1940							
Apr.	432,746	362,139	70,607	19,687	13,487	6,200	452,433
May	391,215	325,676	65,539	21,277	12,677	8,600	412,492
June	344,636	286,040	58,596	17,930	8,739	9,191	362,566
July	231,703	168,769	62,934	14,468	3,397	11,071	246,171
August	75,873	46,823	29,050	13,993	1,510	12,483	89,866
September	269,108	224,470	44,638	15,475	3,410	12,065	284,583
Oct.	493,223	421,214	72,009	21,151	7,056	14,095	514,374
Nov.	487,352	407,091	80,261	23,621	10,814	12,807	510,973
Dec.	483,567	396,531	87,036	23,364	11,653	11,711	506,931

* Revised.
Note: U. S. figures represent factory sales; Canadian, production.

ADVERTISING PAGES REMOVED

Exports of Crude Rubber from Principal Producing Countries

(Long Tons)

	BRITISH MALAYA							NETHERLAND INDIES						
	Gross Exports	Imports	Net Exports	Ceylon	India & Burma	Sarawak	British North Borneo	Thailand	Java & Madura	Sumatra E. Coast	Other N.I.	Indo-China	Amazon Valley	All Other	World Total
1923	252,016	70,432	181,584	39,971	6,416	5,705	4,237	1,718	32,930	46,344	57,822	5,067	16,765	7,856	406,415
1924	259,706	108,524	151,182	39,997	7,697	6,699	4,621	2,962	42,446	54,497	80,347	6,688	23,165	9,065	429,366
1925	316,825	158,022	158,803	49,566	10,082	5,424	5,377	5,377	46,757	65,499	120,626	7,881	25,298	13,797	514,487
1926	391,328	151,243	240,085	58,962	9,874	9,135	6,079	4,027	52,186	71,413	121,231	8,203	24,298	16,017	621,536
1927	371,322	182,845	188,477	55,356	11,321	10,923	6,582	5,472	55,297	77,815	142,171	8,645	28,782	15,633	606,474
1928	409,430	149,787	259,643	57,267	10,790	10,087	6,698	4,813	58,848	82,511	121,770	9,548	21,129	10,690	653,794
1929	574,836	163,092	411,744	81,584	11,663	11,077	7,381	5,018	65,990	87,789	134,037	9,696	21,148	6,767	853,894
1930	547,043	133,876	413,167	76,970	10,782	10,309	6,781	4,251	69,755	79,396	115,254	7,665	14,260	5,651	814,241
1931	519,740	125,506	394,234	61,769	8,470	10,451	6,247	4,218	75,952	87,747	116,009	11,696	12,121	3,292	792,203
1932	478,252	92,539	385,713	48,973	3,888	6,960	4,664	3,451	61,312	79,837	85,871	13,883	6,450	1,816	702,818
1933	573,412	167,377	406,035	63,351	4,527	10,874	7,555	7,765	73,851	91,861	149,659	18,394	9,883	2,737	846,312
1934	677,361	211,803	465,558	79,746	10,492	17,233	11,103	17,545	87,400	112,058	175,470	20,170	8,903	2,985	1,008,663
1935	590,319	174,652	415,667	54,316	13,968	19,465	8,885	28,327	57,488	78,325	139,297	28,816	11,275	8,745	864,574
1936	520,286	167,799	352,487	49,692	14,724	21,243	8,177	33,702	61,307	84,577	152,205	40,782	14,193	11,466	845,432
1937	681,638	213,446	468,192	70,353	17,015	25,922	13,213	5,551	84,085	139,632	207,863	43,399	15,576	13,063	1,133,864
1938	526,911	156,101	370,810	49,528	15,179	17,792	9,512	41,080	57,526	94,501	145,909	58,518	14,618	12,920	887,892
1939	553,324	177,851	375,473	61,026	15,881	24,014	11,864	41,266	72,786	117,791	181,272	65,140	13,892	22,224	1,002,629

	British Malaya [1]	N.E.I.	Ceylon [2]	India & Burma [2]	North Borneo	Sarawak	Thailand	Indo-China	Oceania	Africa [3]	Liberia	South America	Mexico (Guayule)	Grand Total
1940:														
Jan.	26,229	54,148	7,698	1,672	1,858	2,256	5,722	5,238	185	747	1,191	1,550	389	108,883
Feb.	45,651	37,958	8,946	2,922	1,164	2,678	4,307	6,931	94	834	477	1,662	239	113,863
March	47,885	42,355	5,305	1,941	1,050	3,526	3,111	3,551	178	943	548	1,482	346	112,221
April	25,454	44,416	4,144	1,807	1,799	2,951	1,834	2,927	203	720	598	1,159	317	88,329
May	37,874	40,436	7,337	2,018	1,370	2,696	2,582	4,578	195	961	364	2,305	331	123,047
June	45,471	44,834	5,603	1,553	1,421	4,077	2,178	2,730	168	727	405	1,080	101	110,348
July	42,861	60,482	7,330	1,194	1,767	2,494	4,253	4,045	169	800	342	1,035	443	127,215
Aug.	45,872	45,078	8,139	1,332	1,593	2,640	4,545	7,337	285	800	308	1,233	327	120,729
Sept.	58,892	44,009	9,985	1,319	1,743	2,404	3,247	9,303	100	800	323	1,295	200	133,715
Oct.	52,767	50,139	8,127	1,841	1,693	2,564	3,355	2,082	200	800	600	1,860	200	126,228
Nov.	36,045	37,387	5,623	2,626	1,130	3,360	3,463	6,715	200	800	600	1,500	200	99,649
Dec.	.....	.....	.....	.....	.....	.....	....	....	...	...	...	....	...	.....

(1) Including Brunei and Labuan; figures shown represent rubber which has actually been shipped and include rubber from the free stocks in Singapore and Penang. (2) Exports of domestic produce. (3) Exclusive of Liberia. Notes: Figures shown prior to 1940 were furnished by the United States Department of Commerce. Figures since 1940 were furnished by the International Rubber Regulation Committee, which accounts for the difference in the principal producing countries shown. Many figures for current months are provisional only and are later revised when more definite statistics are available. Therefore, it is suggested that figures from the most recent issue should be taken as more reliable.

Net Imports of Crude Rubber into Principal Manufacturing Countries

(Long Tons)

	United States [1]	United Kingdom	France (h)	Germany	Canada (ac)	Japan (da)	Italy	Russia (ce)	Australia (cd)	Belgium (d)	Netherlands	Scandinavia (abcdf)	Spain (g)	Czechoslovakia (abcd)	Total
1919	238,407	42,671	17,685	5,584	6,395	9,753	9,894	75	1,002	3,995	2,771	3,149	2,418	9	343,808
1920	249,530	56,844	13,885	11,890	11,746	5,297	6,123	62	1,815	3,840	5,510	2,292	2,008	567	371,409
1921	179,736	42,087	15,135	21,926	8,124	21,713	3,906	165	1,014	1,705	1,022	1,279	2,245	569	300,620
1922	296,594	11,724	24,352	27,546	9,207	15,934	6,430	2,493	2,643	172	—3,807	1,778	589	567	396,222
1923	301,527	12,700	27,392	18,519	13,277	15,372	8,489	2,986	1,649	2,184	792	2,528	630	1,128	409,173
1924	319,103	—11,550	30,446	22,727	14,299	19,571	8,764	2,346	3,124	2,688	—807	3,178	944	1,370	416,203
1925	385,596	4,061	32,956	33,937	19,683	11,117	11,412	7,088	4,757	2,930	973	3,149	1,155	1,558	520,274
1926	399,981	84,865	34,240	22,775	20,229	18,125	9,809	6,529	9,021	2,498	2,670	4,046	1,299	1,870	617,957
1927	403,472	60,249	34,271	38,892	26,403	20,521	11,392	12,018	9,490	6,482	636	4,224	2,055	2,672	632,768
1928	407,572	4,846	36,498	37,855	30,447	25,621	12,433	15,134	8,430	7,958	2,243	4,418	3,178	3,138	599,771
1929	528,608	122,675	55,093	49,275	35,453	34,284	17,169	11,774	15,886	9,445	3,022	6,440	864	4,650	894,638
1930	458,036	120,069	68,503	45,488	28,793	33,039	18,639	16,387	5,354	10,635	2,924	7,710	2,400	4,468	822,445
1931	475,993	86,170	46,466	39,688	25,261	43,483	10,149	30,671	7,649	11,009	2,220	6,360	2,605	7,717	794,641
1932	393,844	44,086	42,506	45,121	20,917	56,027	14,469	30,637	12,576	9,519	2,851	7,262	4,359	9,444	693,618
1933	398,365	73,335	61,953	54,120	19,332	66,831	19,341	29,830	13,534	11,166	1,243	7,831	5,520	10,402	772,803
1934	439,172	158,482	49,560	59,330	28,439	69,905	21,398	47,271	9,642	9,115	3,758	12,418	6,900	10,999	926,389
1935	455,758	128,829	51,450	62,899	26,870	57,567	21,880	37,572	9,978	7,593	4,068	11,878	8,140	11,245	895,727
1936	475,359	—2,591	57,032	71,794	27,871	61,223	16,534	30,967	14,109	9,648	2,888	11,236	6,668	8,772	791,510
1937	592,394	92,707	59,871	98,170	36,088	62,311	24,733	30,462	19,164	14,970	4,343	4,680	2,400	13,063	1,055,356
1938	406,343	133,079	59,660	90,200	25,696	45,836	28,170	25,650	11,944	11,309	5,092	16,034	2,400	9,936	871,349
1939	486,348				31,615	42,352			15,426	9,612	7,051				
1939:															
May	45,390	7,531	4,646	8,413	3,006	4,438	1,573	2,000*	1,188	792	518	1,654	200*	618	81,967
June	33,951	8,439	4,649	8,190	2,423	3,067	1,992	2,000*	1,308	621	672	2,703	200*	487	70,702
July	36,932	4,040	4,282	8,437	3,164	3,668	1,408	1,000*	1,422	859	565	824	200*	412	67,155
Aug.	38,319	2,044	4,000*	....	2,033	3,145	1,500*	2,000*	2,182	952	651	1,546	200*	400*	58,972
Sept.	36,197	4,406	4,000*	....	2,639	9,254	1,500*	2,000*	875	108	222	1,200*	200*	...	62,601
Oct.	39,735	8,530	5,000*	....	5,787	2,749	1,500*	2,000*	1,235	519	653	1,200*	200*	...	69,108
Nov.	41,478	10,500*	5,000*	....	1,709	5,104	1,500*	2,000*	1,200*	667	613	1,200*	200*	...	71,171
Dec.	70,302	5,200*	5,000*	....	3,025	3,961	1,500*	2,000*	1,200*	1,035	1,827	1,200*	200*	...	96,450
1940:															
Jan.	71,565	450	5,000*	....	5,047	4,540	1,500*	2,000*	1,921	891	682	1,200*	200*	....	....
Feb.	41,797	7,500	5,000*	....	3,508	5,241	1,500*	2,000*	1,846	694	495	1,200*	200*	....	....
Mar.	58,302	14,200	5,000*	....	3,062	6,057	1,500*	2,000*	1,784	....	627	1,200*	200*	....	....
Apr.	70,135	16,400	5,000*	....	3,096	2,000*	1,500*	2,000*	1,612	....	....	1,200*	200*	....	....
May	50,610	10,000	5,000*	....	3,108	2,500*	1,500*	2,000*	2,128	....	....	1,200*	200*	....	....
June	53,266	9,500	5,000*	....	1,062	3,000*	1,500*	2,000*	1,181	....	....	1,200*	200*	....	....
July	69,496	19,500	5,000*	....	5,112	3,000*	1,500*	2,000*	1,902	....	....	1,200*	200*	....	....
Aug.	72,612	21,250	5,000*	....	4,605	4,500*	1,500*	2,000*	2,508	....	....	1,200*	200*	....	....
Sept.	78,306	25,940	5,000*	....	2,743	....	1,500*	2,000*	2,485	....	....	1,200*	200*	....	....
Oct.	74,400	.....	5,000*	....	....	....	1,500*	2,000*	1,590	....	....	1,200*	200*	....	....
Nov.	72,775	.....	5,000*	....	....	....	1,500*	2,000*	1,200*	....	....	1,200*	200*	....	....
Dec.	.....	.....	....	....	....	....	....	....	....	....	....	....	....	....	....

a—Including gutta percha. b—Including balata. c—Re-exports not deducted in monthly statistics. d—Including some scrap and reclaimed rubber. e—Official statistics of rubber imports by Soviet Russia. f—Including Norway, Sweden, Denmark and Finland. g—United Kingdom and French exports to Spain except in years prior to 1925. h—French imports have been reduced in order to eliminate imports of gutta percha and to reduce to basis of net weight. [1]—United States imports of guayule are included in this compilation. *—Figure is provisional; final figure will be shown when available.

NOTE: ANNUAL FIGURES ARE MORE ACCURATE: THEY ARE REVISED AT THE END OF THE FOLLOWING YEAR.

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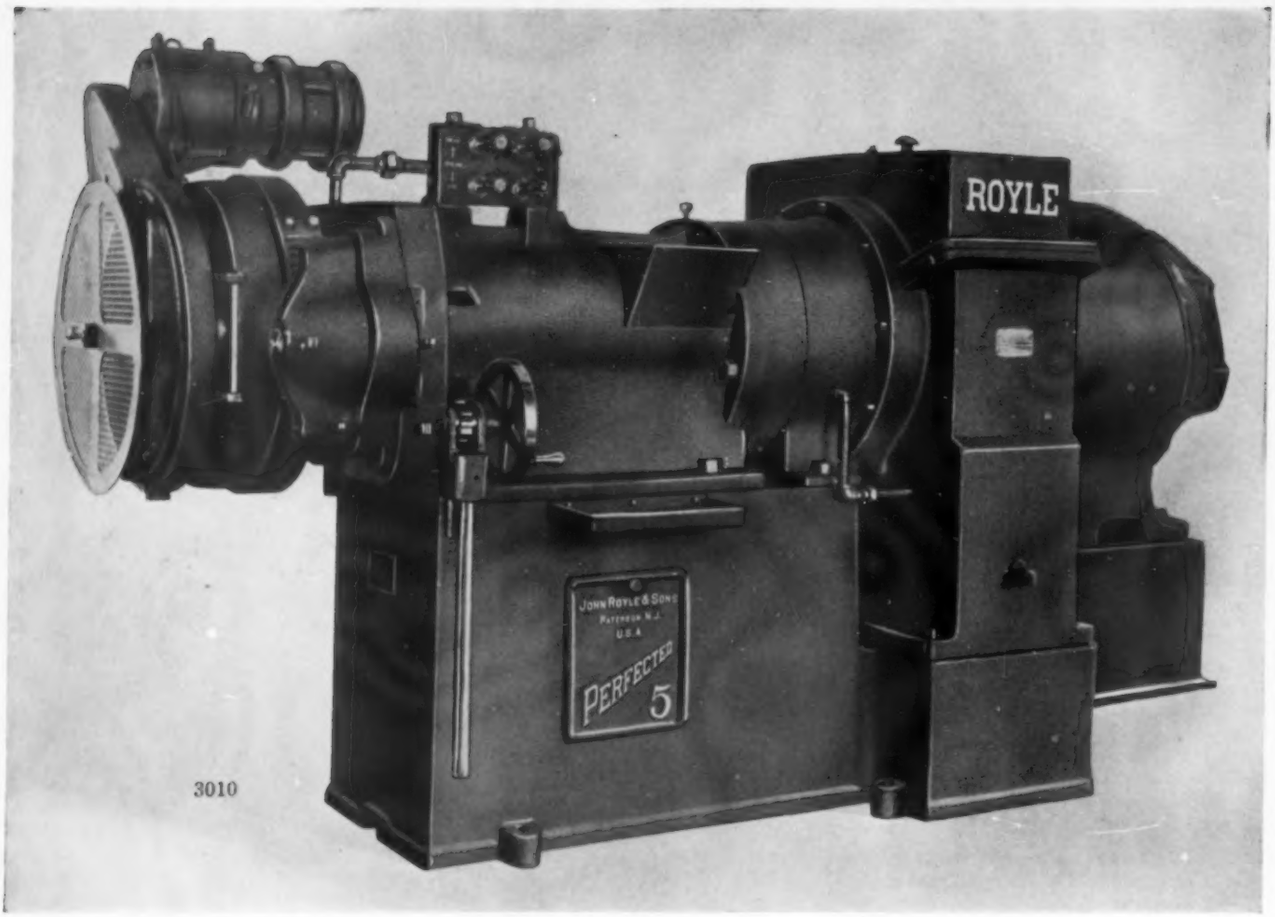

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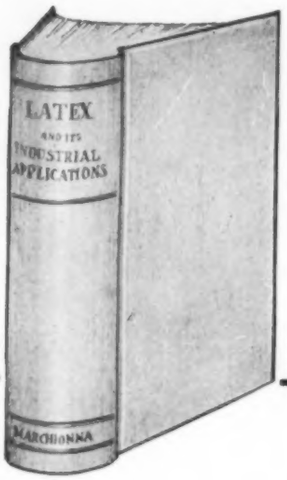

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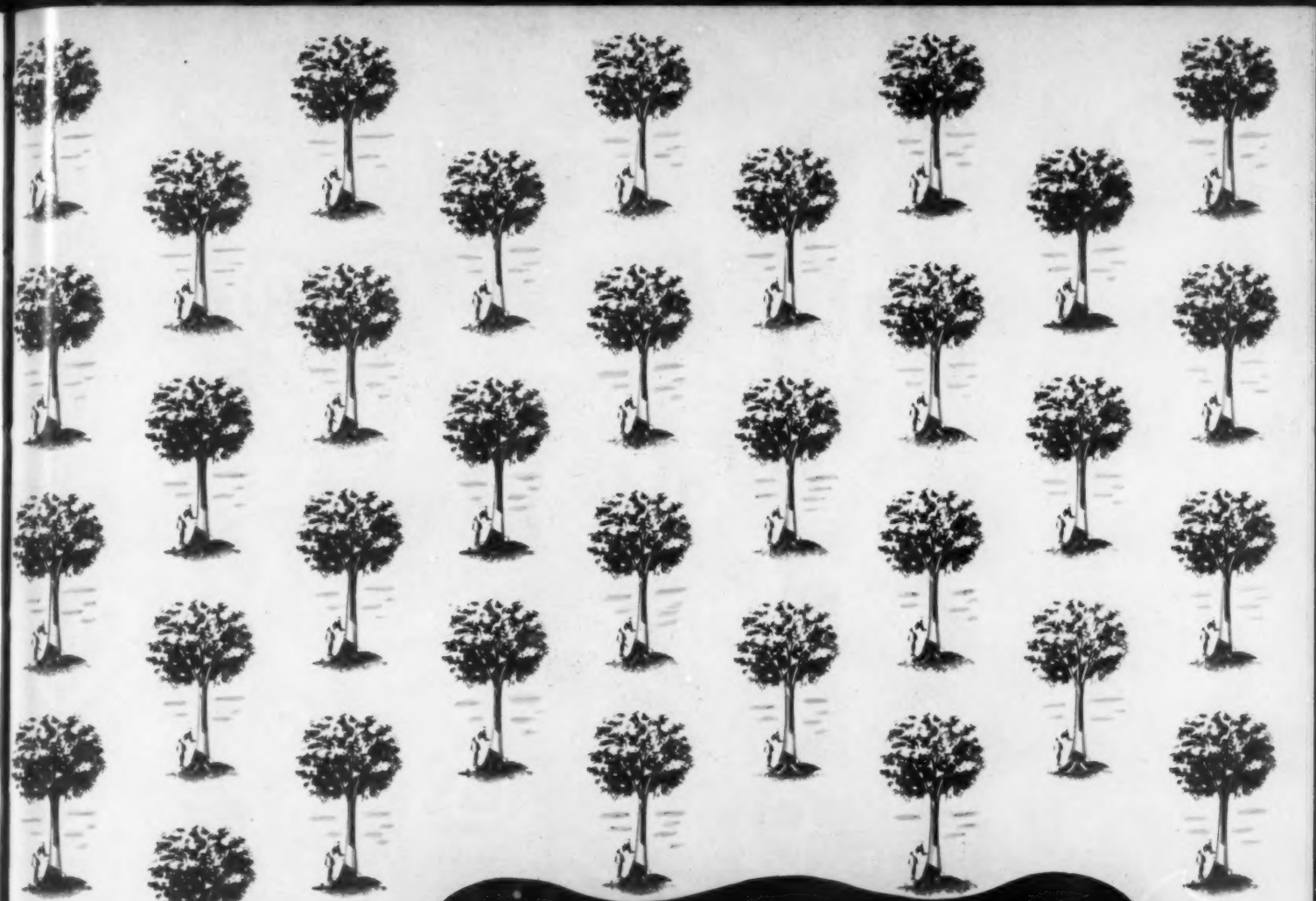

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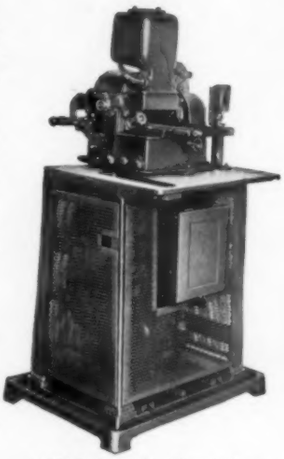

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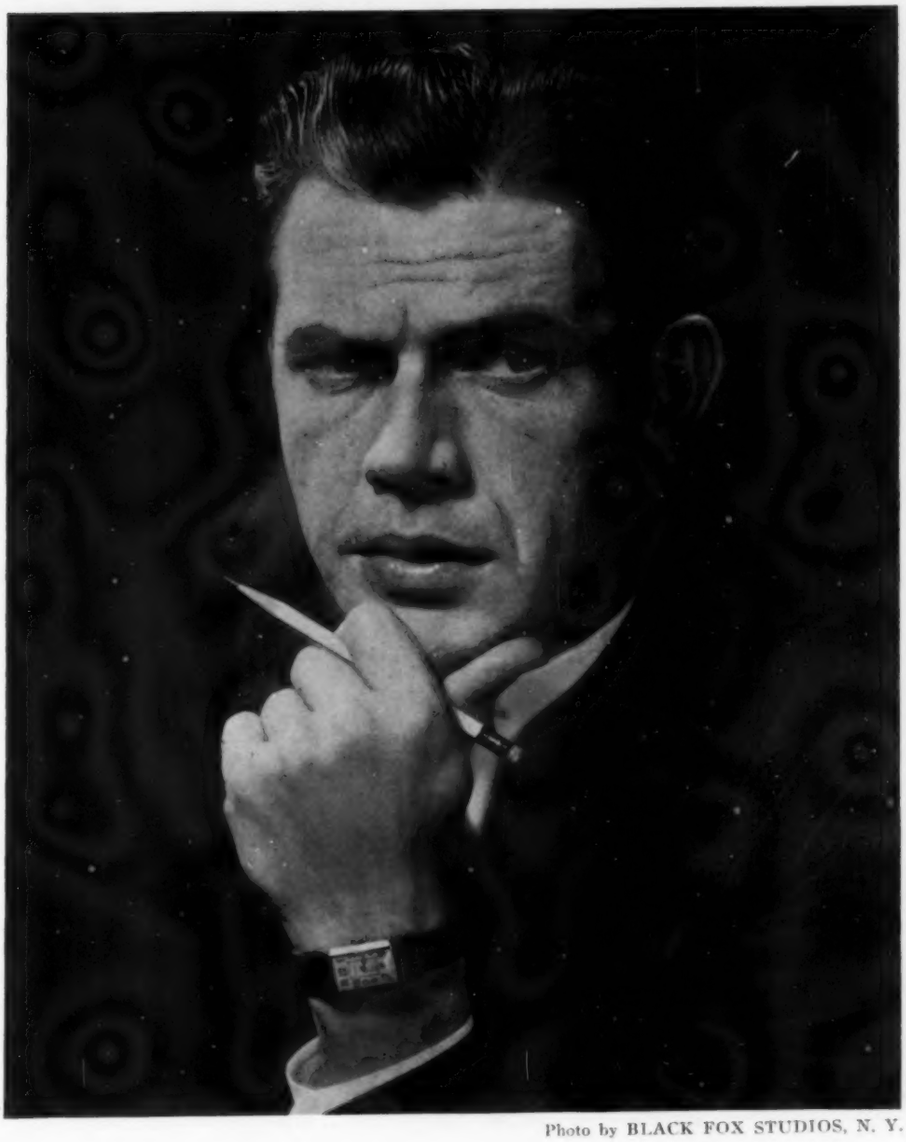

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TODAY buyers are sorely up against the problem of locating additional suppliers capable of furnishing materials and equipment to enable rubber factories to meet the greatly increased production schedules demanded by emergency conditions.

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Have you seen this issue of *The* ACTIVATOR?

VI 1

SEVERAL years ago we inaugurated the publication of a series of rate of cure charts to familiarize the rubber chemist with the results to be expected with various types of zinc oxides when used with various accelerators in rubber compounds. One point brought out repeatedly in these charts was that it is not easy to predict precisely the behavior of different types of zinc oxide in rubber compounds. The presence of other compounding ingredients, curing conditions—whether high or low temperature—the accelerator, the sulfur ratio, all tend to affect the results obtained with different types of zinc oxide.

Also, it was definitely established that when zinc oxide is used solely for activation (in amounts of approximately 5% on the rubber) there is generally very little practical difference in curing rate between zinc oxides of different types with either acid or alkaline type accelerators. The differences between the two general types of zinc oxide (fast curing and slow curing) become significant only when higher loadings are employed (e. g. 18 volumes).

The results of some of these tests are of particular interest to the rubber industry at this time, and they are being resubmitted in this edition for your consideration for the following reasons.

1. An unprecedented demand for zinc metal, caused chiefly by the national defense program, has necessitated our limiting the production of all of our zinc pigments produced from the metal in order that the greatest proportion of our metal output may be made available for use in the various products vital to defense. To be more specific, this limitation applies to all of our French Process and Palmerton Process (Kadox) Zinc Oxides, several grades of which have been used in increasing quantities in the rubber industry for a variety of products.

2. Fortunately, these special brands of metal zinc oxides to a large extent can be replaced in

THE New Jersey Zinc ACTIVATOR

"ZINC PIGMENTS IN RUBBER"

FEBRUARY, 1941

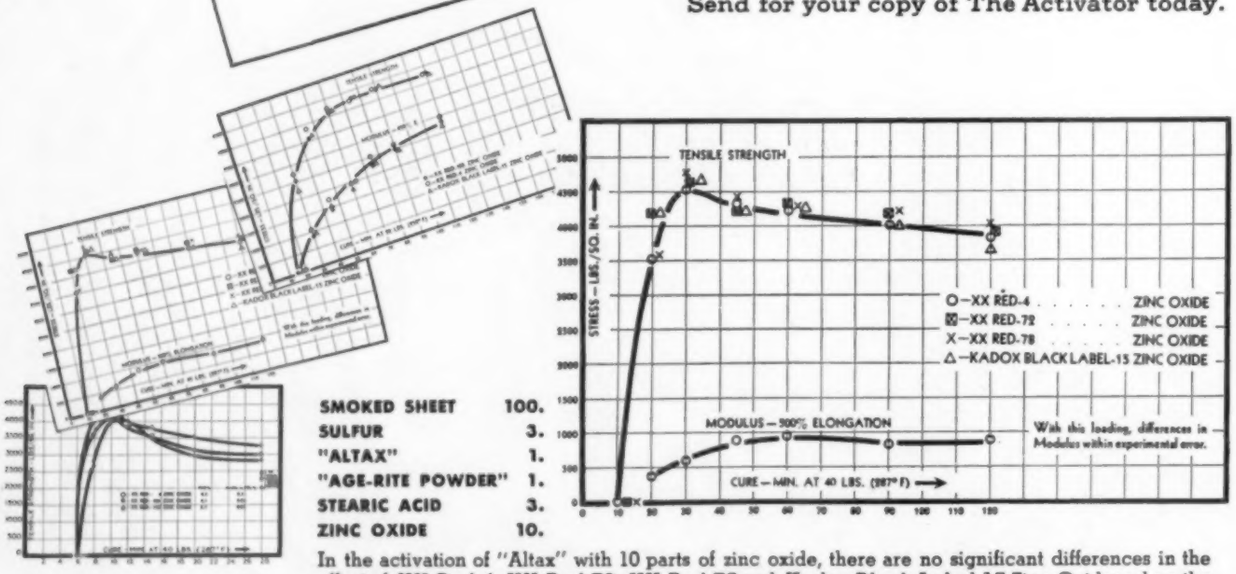
your present compounds by American Zinc Oxides which at present and for th will be more readily available. The sented in the charts should be o assistance in reviewing your compo termine the suitability of American Oxides for your particular requiren

Up to the present time we ar port that we have been able supply the pigment requiremen customers in the many indust view of existing conditions. are beyond our control, w make accurate predictions fo fore, as our position in re made from metal is as vit many good customers ir we feel that this stat will be of mutual ber We offer you our facilities of our Rese you in working out t are mutually concer

This issue of The Activator discusses a matter of vital interest to everyone in the rubber industry at this time.

What type of zinc oxide is best suited to your particular compounds—Fast curing?—Slow curing? How do these oxides work with various accelerators? Can you replace a French Process Zinc Oxide with one made by the American Process? The data presented in this publication may help you to answer these questions in their relation to your compounds. Many interesting results obtained with various combinations of rubber compounding ingredients are illustrated in "rate of cure" charts, typical of which is shown below.

Send for your copy of The Activator today.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MODULUS—500% ELONGATION
With this loading, differences in Modulus within experimental error.
CURE—MIN. AT 40 LBS. (287° F.)

SMOKED SHEET	100.
SULFUR	3.
"ALTAX"	1.
"AGE-RITE POWDER"	1.
STEARIC ACID	3.
ZINC OXIDE	10.

In the activation of "Altax" with 10 parts of zinc oxide, there are no significant differences in the effect of *XX Red-4, XX Red-72, XX Red-78* and *Kadox Black Label-15* Zinc Oxides when the curing temperature is 287°F.

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